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WATER WORKS,
STREET RAILWAYS.

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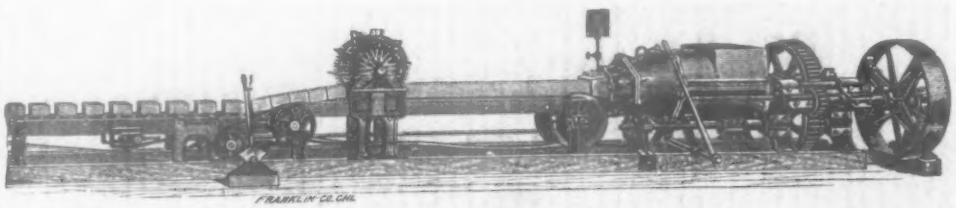

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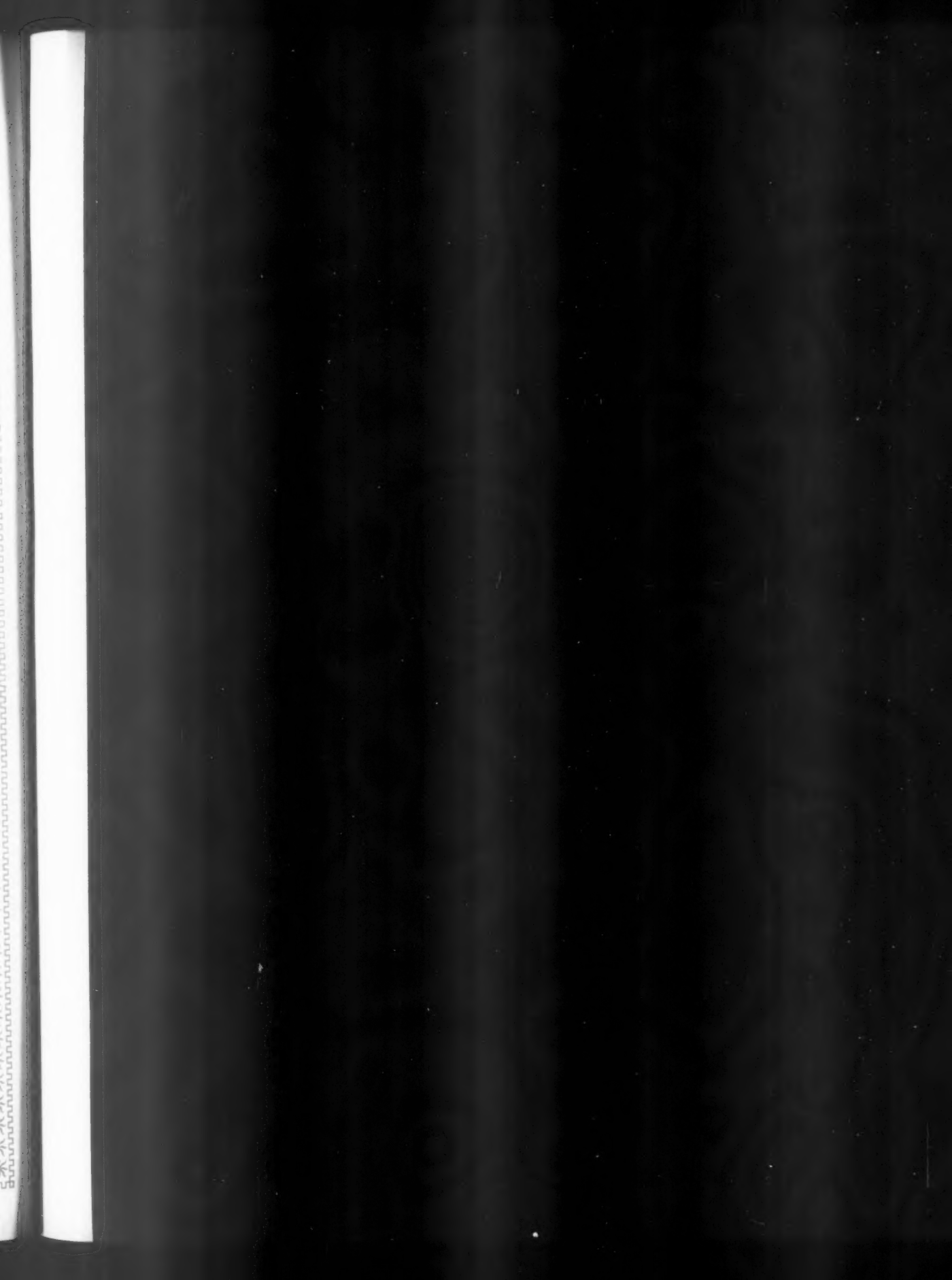


Paving and Municipal Engineering

VOLUME X. MARCH, EIGHTEEN NINETY-SIX. NUMBER 3.

PRODUCTION OF ASPHALT IN THE UNITED STATES.

In the sixteenth annual report of the United States Geological Survey, which has just been issued, it is stated that the production of asphalt in this country in 1894 was 9,790 short tons valued at $195,800 and of bituminous rock 50,780 tons valued at $157,600, making a total of 60,570 tons, valued at $353,400. Compared with 1893 this shows an increase in product of 12,791 short tons, but a decrease in value of $18,832. The increased production was due to greater activity at the bituminous sandstone mines, both in California and Kentucky, while a decrease in the purer forms of asphalt in California and Utah is accountable for the decrease in value. There was no bituminous limestone mined in Utah during 1894. Divided by states, the product was as as follows:

States.	Short tons.	Value.
California	51,187	$251,991
Kentucky	5,383	21,409
Utah	1,000	35,000
Texas	3,000	45,000
Total	60,570	$353,400

The following table shows the annual production of asphaltum and bituminous rock in the United States since 1882:

Years.	Short Tons.	Value.	Years.	Short Tons.	Value.
1882	3,000	$10,500	1889	51,735	$171,537
1883	3,000	10,500	1890	40,841	190,416
1884	3,000	10,500	1891	45,054	242,264
1885	3,000	10,500	1892	87,680	445,375
1886	3,500	14,000	1893	47,779	372,232
1887	4,000	16,000	1894	60,570	353,400
1888	50,450	187,500			

Prof. S. F. Peckham reports that during 1894 no new discoveries of asphalt were made in Southern California. The California

Petroleum and Asphalt Company, with mines at La Patera, above Santa Barbara, on the coast, and works for extracting maltha from the land at Carpenteria, on the coast below Santa Barbara, supplied a moderate demand for its products, but during the year was largely engaged in introducing machinery for more extensive operations in the future.

The total amount of hard and liquid asphaltum produced in California during 1894 was 5,790 short tons and of bituminous rock 45,397 short tons, the aggregate value of which was $251,991.

The product from Utah "includes the fine form of bitumen known as gilsonite or gum asphaltum and a bituminous limestone." None of the latter was mined during 1894, while the product of gilsonite or gum asphaltum was 1,000 tons, valued at $35,000.

Very little information was obtainable regarding the litho-carbon properties in Uvalde county, Texas, owing to complications likely to arise in the acquirement of title to lands.

The production of bituminous sandstone in Kentucky for street paving in interior cities was 5,383 short tons, valued at $21,409, against 1,129 tons, valued at $6,570 in 1893.

Special mention is made in the report of a deposit of asphalt in Park county, Montana, examined by Prof. William C. Day. "The material," the expert says, "is not solid at ordinary temperatures, but liquid enough to form slowly. The ash contained in it amounts to 0.69 per cent. The asphalt contains quite a mass of foreign materials, such as leaves and the claws and feathers of birds, and fragments of insects, which must have been caught in the material." The material soluble in carbon bisulphide (bitumen) was found by Prof. Day to be 95 per cent., which he thinks compares favorably with Bermudez asphalt. The material soluble in gasoline (petrolene) was 80 per cent. A combustion of the material gave the following result as to total carbon and hydrogen: Percentage of carbon, 79.81; percentage of hydrogen, 9.29. The percentage of sulphur was 2.83. Seventy-four grams of the substance were introduced into a distilling flask by aid of a filter pump; the viscosity of the material was such that it took several hours to transfer about 100 cubic centimeters to the flask. A Bunsen flame was applied directly to the flask; the material frothed considerably, giving a gas which was collected and measured. The gas given off at this stage

amounted to 2,250 cubic centimeters. When a thermometer placed with the bulb in the vapor (i. e., a little below the side tube of the distilling flask) showed 98° C. the frothing ceased and a liquid distilled over between 98° and 110°; the weight of this fraction was 6.75 grams. The second fraction was taken between the limits 110° and 170°; its weight was 2.3 grams. The third fraction was taken between 170° and 225°; its weight was 8.75 grams. The last fraction was from 225° to the limit of the thermometer; it weighed 22.5 grams. The last fraction was accompanied by the more rapid evolution of gas which had decreased at 98°. Between 98° and 225°, 1,000 cubic centimeters of gas were produced.

The amount of gas evolved at this final stage was 2,500 cubic centimeters, thus making in all 5,750 cubic centimeters of what, on burning, proved to be a good illuminating gas. "The residue left in the retort," the report says, "after distillation looked like valuable material for paving, being at ordinary temperatures hard and brittle, with a lustrous conchoidal fracture."

The imports of asphaltum into the United States include hard asphaltum from Cuba, Trinidad asphaltum from the Island of Trinidad, off the coast of Venezuela, South America, and bituminous limestone from Neufchatel and Val de Travers, in Switzerland, and Seyssel, in France. The following table shows the imports of crude asphaltum since 1867:

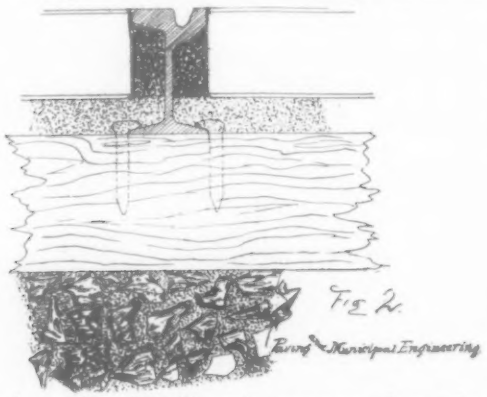
Years ended—	Quantity.	Value.	Years ended—	Quantity.	Value.
	Long tons.			*Long tons.*	
June 30, 1867.....	.....	$6,268	June 30, 1881.....	12,883	$95,410
1868.....	185	5,632	1882.....	15,015	102,698
1869.....	203	10,559	1883.....	33,116	149,999
1870.....	488	13,072	1884.....	36,078	145,571
1871.....	1,301	14,760	1885.....	18,407	88,087
1872	1,474	35,533	Dec. 31, 1886.....	32,565	108,528
1873.....	2,314	38,298	1887	30,808	95,735
1874.....	1,183	17,710	1888.....	36,494	84,045
1875.....	1,171	26,006	1889.....	61,952	138,163
1876.....	807	23,818	1890.....	73,861	223,368
1877.....	4,532	36,550	1891.....	102,433	299,350
1878.....	5,476	35,932	1892.....	120,255	336,868
1879.....	8,084	39,635	1893.....	74,774	196,314
1880.....	11,830	87,889	1894.....	102,505	313,680

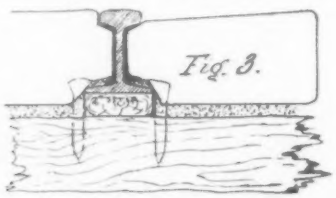
BRICK PAVING FROM START TO FINISH.

By M. Nicholson, C. E.

IV. PAVING NEXT TO STREET RAILWAY TRACKS—THE FINISHING TOUCHES.

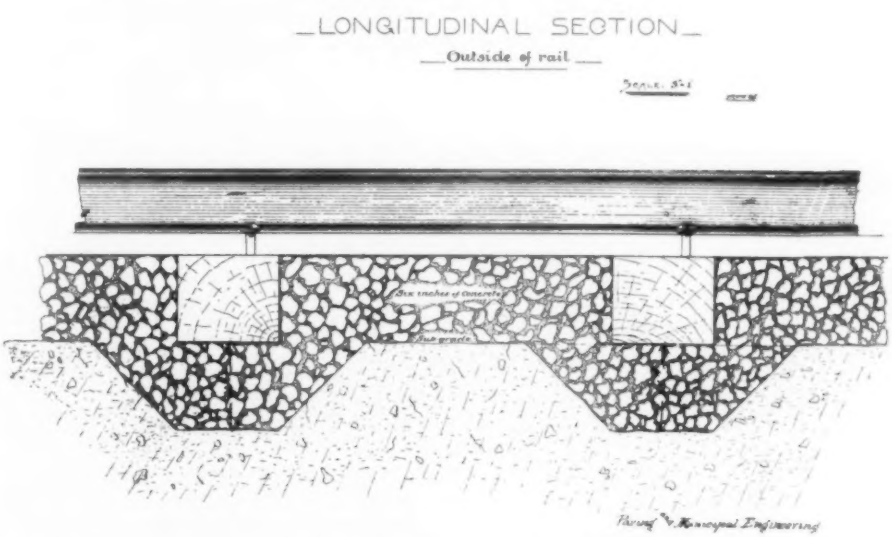
THE question of paving next to street car tracks is one that has vexed engineers and paving contractors more than any other detail of the whole work. The variation in size and shape of rails and manner in which they are laid is such that almost every job requires a different solution. The easiest rail to pave against, the easiest to travel over, and I believe the best in every respect is the grooved girder rail; while the most difficult to pave against, the worst to drive over and the most difficult to maintain a pavement against is the ordinary T rail. The best method I have seen of overcoming the trouble with the T rail is by using a special shaped brick that fits under the head of the rail and against the web, and is beveled back on top about three inches, and enough on the bottom to clear the base of the rail. Such a shape was illustrated in an issue of PAVING AND MUNICIPAL ENGINEERING in January, 1894. The next best method is to lay the regular brick with its top about three-fourths to one inch below the top of the rail and about one-half inch away from the inside edge of the head; then fill the space between the brick and rail with a concrete of hot gravel, or sand and pitch, or asphalt. In any case the rail should be deep enough itself or so laid as to allow a full depth of sand bed between the brick and top of cross-tie when the brick is laid with its surface on the final grade. The accompanying illustrations show different methods of paving against the three different forms of rails most commonly used in car tracks, and illustrate what I consider the relative order of merit of rail and manner of paving. In the illustration of the





transverse section and Fig. 2, the space between the rail and brick will necessarily have to be filled with a concrete of hot sand and pitch or asphalt, as gravel could not be gotten into the space on account of the brick being against the rail at the top, thus closing, or very nearly so, the only place through which the space could be filled.

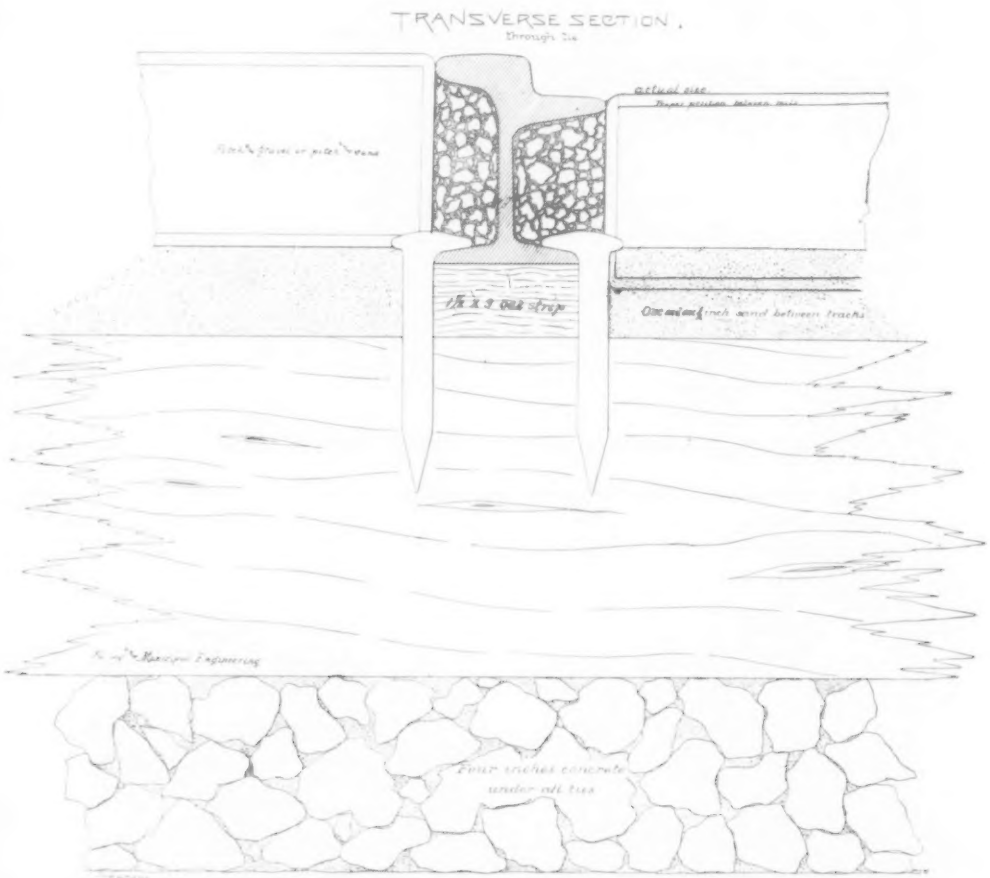
When the brick have been laid and the surface swept clean of all rubbish, they should then be settled to a final surface with a four to six ton horse roller, rather than with rammer and flatter. The use of the roller for surfacing the brick and settling them to a uniform bearing in the sand, has several important advantages over the rammer and flatter, the most important one being the greater evenness and uniformity of the surface produced, a detail that is



often slighted or neglected entirely, and yet the thoroughness with which it is done will contribute as much to the durability of the pavement as any detail of the whole construction.

Any one who has watched the action of traffic on a pavement for any length of time will notice that the brick do not wear away over the whole surface exposed, but show the first signs of wear by chipping or grinding off on the edges. When the edges are all flush they are practically protected from blows of wheels, thus reducing chipping from this source to a minimum, and being flush,

with the joints filled solid, they offer much greater resistance to chipping from blows of horses' feet, thus reducing the effect of traffic on them very materially, in addition to increasing the comfort of riding over them, diminishing the tractive force necessary to move vehicles, and making the pavement decidedly easier to



clean. I have never tried by actual experiment to demonstrate just what the difference would be between a pavement laid with every brick exactly flush with those adjoining it, and one laid with exposed edges, so I can not give figures for comparison, but I think such an experiment would prove interesting and instructive. I have demonstrated to my own satisfaction, however, that a large horse roller, from four to six tons, such as is usually used to roll

the sub-grade, will give a surface far superior to that produced by the use of a rammer and flatter, which are only useful in driving down single brick or portions of the pavement that can not be reached by roller.

After rolling and ramming is completed two or three men with brick tongs should go carefully over the whole surface and remove all brick broken or badly spoiled or showing bad fire cracks, or any under or over-burned ones; also to raise or lower any which are not on perfect surface.

Finally we come to the interstitial filling. I am a firm believer in a good quality of coal tar pitch, but whether pitch or asphalt, or a mixture of the two, or hydraulic cement, or what is known as Murphy's grout, be used, it should be so thoroughly applied as to make the pavement water-proof, for I am decidedly of the opinion that the use of sand as a filling should be avoided at any cost. Any one who has had occasion to take up a pavement when the joints were not filled with water-proof material will, I believe, agree with me that every joint that is not made water-proof becomes a receptacle for filth that will very soon defeat one of the most important objects to be accomplished by the construction of the pavement, which is perfect sanitation. In applying the pitch it should always be kept as hot as possible and applied only when the brick are dry, as fast as it is poured into the joints, and heated to at least 300 degrees, should be spread over the surface of the pavement. The heating of the sand is necessary, of course, only when pitch or asphalt is used, with which material it forms a concrete, by sinking into it, and lessening its tendencyto flow, besides making the surface much less slippery when the pavement is first used and before the surface coat of pitch is worn away. When the hot sand has been applied and allowed a few hours to sink into the pitch, the pavement is ready for traffic, the work is done and you have a modern brick paved street that under almost any ordinary traffic is good for ten or fifteen years' service with little or no repairs.

M. NICHOLSON, C. E.

THE CONTRACTOR'S FAIR PROFIT.

*By J. H. Burnham.**

MEN are generally said to be in business for profit, although there may be a very few cases where they follow business for their health. While it is perfectly proper to discuss the question of pay or profits due the profession of engineering, it is also equally proper to consider what is a fair profit for contractors.

There are three classes of engineers. One class consider it t hei sole business to see that no profit whatever is made by contractors. Another class is sometimes said to be at the opposite extreme, and to be perfectly willing that contractors shall make any amount of profit, asking, however, a percentage of the profit for themselves.

We will assume neither of these classes are represented, but that all are in the large class to be found between these two extremes, and willing to see contractors make a fair profit.

To the general public the prevalent idea is that all contractors are rich, or rather that the contracting business is quite sure to make a man rich. Too many of you, from your own observations, are tempted to believe that no contractor ever gets rich, that they all belong to an endless procession marching recklessly toward financial graves. Fresh victims are constantly joining the ranks of this procession, and there need be no fear that the line will ever falter or the public interests suffer for the lack of proper bidding material. Quite possibly this may be the truth, and yet some may have a lingering desire to see enough substantial and honorable contractors to form at least an excuse for basing estimates upon the possibility that some portion of the public money may be so expended as to fall into the hands of men who will not consume the whole amount in work performed at actual cost, or less. It is fair to assume that all bidders, all contractors, ought to expect to perform their contracts in strict accordance with fair and intelligent specifications. It is also right to assume that these contractors shall not only bid to thus perform their work, but shall also bid so as to give themselves a fair profit on their contracts. They are in the business for the profits and for nothing else. It is their right, their

* Abstract from address before Illinois Society of Surveyors and Engineers, January 31.

undoubted right, also, to bid for all the profit they can get. They have as much right to all the profit they can obtain as any one else has to all he can earn in his business or profession.

Suppose we analyze the elements of the cost of the work, adding thereto a fair profit.

First, there will be the cost of the materials used in construction. This cost should be made of the very lowest possible prices to be obtained by purchase, in as large lots as possible, from the very best dealer to be found, promptness of delivery and reliability of seller being elements to be duly considered.

Second, economy in labor must be studied by the contractor, and no drones or useless laborers should be allowed on the work. How far this item in economy in labor should be pursued is a question for consideration. A class of contractors may be found in some lines of work who always employ low-priced foreign labor, and in some extreme cases they have been known to run saloons or boarding houses at which their laborers are obliged to spend quite a large portion of their earnings. This sort of competition must often be met by contractors, and the inevitable tendency of modern competition seems to show that our system of letting public work to the lowest bidders will very soon drive many lines of contracting into the hands of this, or a lower class of contractors. Sooner or later the law or the people must grapple with questions like this, and we already have a forewarning of what is coming by the passage in the state of Illinois of a law three years ago which provides that public money shall not be paid to foreign laborers who have not taken out their first naturalization papers. This law is as yet little known, and it is very important that it should be enforced. Closely related to the question of low-priced unnaturalized foreign labor, comes that of the employment of union labor, or workingmen who belong to some labor union which assumes to fix wages in certain trades at a living rate, and also manifests great hostility to the employment of labor at prices below those fixed by the union. We have a premonition of what is coming in this direction in the stand taken by Governor Altgeld, who insisted last season that certain state contracts should be let not to the lowest bidder, but to contractors who would agree to employ none but union labor.

These allusions to low-priced foreign labor, and to union labor,

are thrown in by me not because I am using them as arguments directly, but to help illustrate the difficulties which must be met by contractors under our present laws and customs, and to intimate my own belief that the time is coming when the government will interfere to improve the almost barbarous conditions under which public competition must now be met, conditions which will soon drive all honorable-minded American contractors into other business.

Coming back from this digression, we return to another item of the cost of contracting, which is:

Third, a fair remuneration must be charged for the use, or wear and tear of all tools, plant and appliances for performing the work. These should be of the latest make and the contractor is entitled to charge a proper proportion of their cost and renewal, all under the head of maintenance of plant.

Fourth, if his contract is a very small one, and is in certain lines, he will not have much expense for superintendence, while in other lines he will be justly entitled to a large consideration for superintendence, or perhaps it should be called his own skill, or for his technical knowledge of the business. In most cases he is obliged to maintain an office, with its corps of clerks, typewriters, engineers, etc., all of which must be sustained by a certain percentage upon the gross amount of contracts performed during the year. This item of cost being out of sight is often forgotten, but I wish to call attention to it particularly and to emphasize its great importance.

Fifth, interest at the full legal rate should be allowed on all of the capital employed in the purchase of materials or labor used in the performance of any contract, as a matter of course, and another amount should be considered as contingent expenses, or an estimate of the average cost of accidents to men and disasters incident to the business.

Sixth, up to this point no mention has been made of a profit, and nothing has been specified excepting items of cost against which no one will make a reasonable objection, although the methods of computing these items may vary widely. We come now to what is the contractor's fair profit, to be added to complete the final list bid.

I suppose no one will question his absolute right to obtain a

margin large enough, reckoned upon his gross amount of contracts, to cover not only the expenses referred to, but to give him in addition a margin which will in time enable him to provide some accumulation for old age.

This profit should, of course, vary much with circumstances, being lightest in those lines of work which are of the simplest and most common character, such as are most likely to be commonly met and most easy to handle, and the highest where the work is the most complicated and the most difficult to manage. A clear ten per cent. may be a good profit on some jobs, reckoned on the basis given above, while in other cases fifty per cent. would not be enough, and I will not make an attempt to lay down a rule under this head.

Having enumerated the items of cost to be considered, I hope I have brought to notice certain elements of cost to which but little attention may have been given. I am aware that when engineers are employed on public work, they have but little chance to throw it into the hands of the best class of contractors, and yet it does often happen that certain portions of a contract, and even entire jobs, are let with nothing to prevent a fair contract price, where the employer or the public, as the case may be, is entirely willing, and even anxious, that the contractor shall do good work at a fair living profit. It also happens that engineers are called upon to make estimates before work is let, and are supposed to include in their estimates, a fair profit to the contractors.

Speaking as a contractor, I am free to say, that but few opportunities are met with in public competition, and they are yearly growing fewer, to obtain any profit at all on work.

In the first place, the lowest bid is frequently made by the most ignorant bidder, or by one who intends to cheat the engineer and the specifications, or by one who intends to employ something very much like Chinese cheap labor, or quite as likely by the stock company which has nearly been driven into bankruptcy, and whose officers are anxious to keep up an appearance of business and draw salaries until the last possible moment.

In making a bid under the present system of public letting, the contractor must, first of all, leave out all idea of profit, as he knows that generally, some of the last mentioned classes of bidders will not

dream of such a thing as profit. He will also realize that some of his competitors will very likely consider that, as they are either soon going out of the business, or into bankruptcy, they will leave out the item of wear and tear of plant. He may know to a certainty that others may have in their employ, or better, know just where to find it, a class of cheap labor, against which it is useless to attempt to compete. There will be other bidders who were never known to pay in full for the materials which they purchase.

In short, in order to secure the lowest bid, he must cut all along the line of items, which I have specified, and if he takes the contract at all, takes it with the full realization that it is done for the purpose of keeping himself advertised as a contractor, hoping to secure enough contracts in other ways to realize in the long run the fair profit to which he believes himself entitled.

It has long been a saying, or maxim, that "competition is the life of trade." A writer of national reputation on the transportation question, has told us that if the maxim had originally started out as the truthful statement that "competition is the death of trade," it would have, perhaps, been accepted by the public as the sum of all wisdom. As matters now stand with the unthinking public, it will require almost Herculean efforts to educate the public mind to a correct understanding of the proper regulation of the great question of competition. The future has, doubtless, great surprises in store for those who still blindly and ignorantly believe in the wisdom of the above quoted saying. The future will successfully grapple, no doubt, with this troublesome question, along with many others not fully understood.

We have an inkling of future government regulation of competition in the law of Illinois before alluded to, concerning the employment of unnaturalized foreigners upon public work. The dictation of Governor Altgeld, in interfering to award a state contract to firms which would agree to employ only union labor—an interference against which there has as yet been no public protest—is an indication that a state law may soon be passed to compel the letting of contracts only to such contractors as will agree to employ union labor, and possibly, to require contracts to be let only at such prices as will give both employer and employed a fair compensation.

It will be but a step farther after legislation once starts in this

direction, to provide that for certain classes of public contracts only duly licensed contractors shall be qualified to perform the work. Something like this line of action, including a combination of the labor and wage questions, or some improvements upon these suggestions, will, no doubt, be among the improvements of the future. Dark and gloomy as may be the contractor's present prospects for a "fair profit," it is confidently to be hoped that for him, as well as for the rest of the human race, "there is a good time coming."

J. H. BURNHAM, of Bloomington, Illinois, is a native of Massachusetts, and was born at Essex, on the north side of Cape Ann, October 31, 1834. His parents were of the old Puritan stock. His mother was Sarah Choate Perkins, and on her mother's side, a Choate, a first cousin of Rufus Choate, the famous lawyer. Mr. Burnham is quite proud of his ancestry. He possesses the genealogy of the Burnham and Perkins families, and can trace both sides back to their homes in England. He is a corresponding member of the Historical Society of Chicago. He wrote the history of Bloomington in 1879, and besides this has prepared quite a number of historical sketches of other localities. Mr. Burnham emigrated to Illinois in the fall of 1855. In the spring of 1858 he came to Bloomington and entered upon a course of study in the normal school, from which he graduated July 4, 1861. Then, the rebellion being in progress, he entered the army as first lieutenant of the Normal Student's Company A, in the 33d regiment Illinois Volunteer Infantry, and was afterwards promoted to be captain. In 1864 he became editor of the *Pantagraph*, occupying this position nearly three years. Capt. Burnham was united in marriage with Miss Almira S. Ives, on the 23d of January, 1866. In 1867 he became a contracting agent in the bridge building business, and has been probably longer in service than any other highway bridge contractor in the United States. He is a member of the Western Society of Engineers of Chicago, and is vice-president of the Illinois Society of Engineers and Surveyors.

CLEANING AND WATERING OF STREETS IN PARIS.

*By Alfred Perkins Rockwell, A. M., Ph. B.**

CLEANING comprises three general divisions:

1. The removal of mud and household refuse, which is done by contract.

2. Sweeping and watering, which is done exclusively by the

* Extract from "Roads and Pavements in France" just published by John Wiley & Sons, New York.

street department, except that sand is furnished by contract as well as the use of some of the sweeping machines.

3. The removal of snow and ice.

The surface (streets and sidewalks) cleaned is about 18,894,000 square yards. The total expense for the year 1893 was $1,850,611, which is a general average of nearly ten cents a square yard.

The removal of mud and of household refuse is made between 6:30 and 8:30 A. M. from April 1 to October 1. Each house-owner is required by law to furnish from 9 P. M. for the several tenants one or more receptacles for refuse which are to be brought out each morning onto the street in front of the house one hour at least before the carts come by; as soon as emptied they are taken into the house.

The contractors furnish their own carts for the removal of this refuse, and become the owners of it. They generally sell it to farmers or kitchen gardeners as manure.

This refuse is said to be a good fertilizer, nearly equal to farm-yard manure, as appears by the following analysis:

	Percentage.
Nitrogen	0.38
Phosphoric acid	0.41
Potash	0.42
Lime	2.57

The city nevertheless has difficulty in disposing of this refuse, due mainly to the objections on the part of adjacent villages to the use of it within their territories or to the carting of it through them. Arrangements have consequently been made with all the principal railways radiating from the city for transporting it at a reduced tariff to more or less remote points. The total amount of refuse removed in the year 1893 was 1,050,000 "tonnes," of which 680,000 tonnes were utilized in the immediate vicinity, 100,000 tonnes transported on the river to distances from six to thirty-seven miles, and 270,000 tonnes transported by railway.

The market value of the fresh refuse varied in 1893 from 12½ to 25 cents a cubic yard, taken on the cart or boat.

The total expense of the removal of all kinds of refuse, including the street sweepings that are not washed into the sewers, was, in 1893, $377,186.

Each of the twenty wards is made the subject of a separate contract for a period of five years, and no one contractor is awarded more than four of these contracts. The contractor furnishes the cart, horse and driver. The city furnishes a street sweeper to assist in loading, a woman to sweep up whatever may have fallen when the refuse barrels are emptied into the cart, and a rag-picker, who remains in the cart and assists.

The expenses attending this method of disposing of the refuse at more or less remote points—and these expenses under the new contracts are 23 per cent. greater than under the former contracts—have led the engineers to study more carefully the methods pursued elsewhere, notably in England. Within the last two years a furnace has been built by the city for burning a certain amount of the refuse, and although the results are understood to be satisfactory, the question is not considered settled, as experiments are still going on.

STREET SWEEPING.

The sweeping of the streets is done by hand or by sweeping-machines.

The force engaged comprises:

		Yearly Pay.	
37	inspectors	$360 to	$396
131	foremen	336	348
612	roadmen	324	
1383	laborers	300	324
951	women sweepers	192	216
408	rag-pickers, paid 24 cents a day for about three hours' labor.		
3522			

The women sweepers are required to work only seven hours a day. The rag-pickers are occupied only while the carts are collecting and removing the household refuse. They keep whatever of value they find, which is estimated to be about 20 cents a day. The others are required to work ten hours a day.

The prescribed routine of service is as follows:

4 to 6:30 A. M.—Sweeping and washing of the sidewalks and the streets; sprinkling of sand where required; general cleaning of the urinals.

6:30 to 8:30 A. M.—Removal of the household refuse and the street sweepings; continuation of the above work.

8:30 to 11 A. M.—Picking up horse-droppings; washing of the

gutters; watering of the streets by watering carts and hydrant hose; thorough cleaning and disinfecting of the urinals. End of the day for the women sweepers.

11 A. M. to 1 P. M. dinner—If circumstances require it, a part of the force continue work and dine later.

1 to 4 P. M. (End of day)—Sweeping by the machines; watering; picking up horse droppings; sweeping of sidewalks; thorough cleaning and disinfecting of urinals; washing of benches, etc.

4 to 7 P. M.—Extra service with extra pay, when necessary for sweeping, watering, washing gutters, or spreading sand.

7 to 9 P. M.—During five months of winter spreading sand on the asphalt and wood pavements.

When the streets are swept during a dry season they are first watered to avoid dust. When the surface is muddy, it is well watered in order to loosen the mud. During a rainy time the sweeping-machines are passed several times in succession over the surface to clean it and remove the puddles of water. When the asphalt or wood pavement is not muddy, it is dried by the rubber-scraper. The dry sweepings are removed in carts. The semi-fluid ones are washed in the gutter in a stream of hydrant water and the fine particles carried into the sewer. The coarse sand is reserved to be used elsewhere, or carried away.

A conspicuous feature is the great abundance of water used to keep the streets clean. The water of the Seine is pumped into reservoirs and is used for this and all other purposes except drinking.

During dry or hot weather the streets are thoroughly washed clean—

Block-stone and macadam pavements every three days.

Asphalt pavements every two days.

Wood pavements every day.

In general, this washing is done between 4 and 8 o'clock in the morning. The gutters are washed twice a day, and the pavements are sanded as often as necessary to prevent their becoming slippery.

The city owns 394 sweeping machines, 100 of which are assigned to the care of the macadam pavements, 234 to general cleaning and 60 kept in reserve for special service.

The cleaning of the sidewalks is done entirely by hand.

WATERING.

The watering of streets is done wholly by the roadmen engaged in cleaning and those in charge of the macadam pavements, and either by means of watering carts or hydrant hose. Formerly it was done by watering carts only, but at present the latter method is adopted wherever practicable as being the cheaper; the cost is stated to be about one-half of that by watering carts.

The watering begins, in ordinary seasons, on the 15th of March on the macadam pavements and ends on the 15th of October; and on other pavements it begins April 1 and ends September 30.

There are two watering periods daily, the first beginning at 5 A. M. and ending at 10 A. M.; the second is from 1 to 5 P. M. In very warm weather the first is continued until 11 A. M., and the second extends from noon to 6 or 7 o'clock.

The area watered by the hydrant hose is, however, as yet only 43½ per cent., while that watered by carts is 56½ per cent. of the whole.

ESSENTIAL FEATURES OF A PARK SYSTEM.

[In a recent report suggesting plans for a park system, Olmstead, Olmstead & Eliot outlined some of the essential features applicable to the park problem in any city, an abstract of which we give below.]

THEORETICALLY, a complete and satisfactory system of parks for a large city should include (1) a central public ground, upon or about which may be grouped the principal public and semi-public buildings; (2) a series of squares or small public grounds so distributed that they may be used freely at all hours and be within a short walk of every one's home; (3) a series of local parks or city parks of greater extent, and having more varied and interesting topographical features, which may be developed into pleasing, but rather restricted, passages of scenery, combined with various artificially decorated features and means for amusement; (4) one, or possibly more, large rural parks, situated on the outskirts of the city, and comprising broad stretches of pastoral or woodland scenery, extending over hundreds of acres of land, where one may walk for an afternoon or drive for an hour or two, at least, without having to go twice over the same ground; (5) one, or possibly more, great

public reservations, situated at some distance from the city, thousands of acres in extent, where most of the ground is left wild or encouraged to become so, where the sense of relief from urban conditions will be complete, and where all may roam at will over the meadows and through the woods without the restrictions necessary in city and even most rural parks; (6) parkways connecting two or more of the public pleasure grounds or forming agreeable approaches to them, and which may be either formal or informal, and combined with irregular (though restricted) stretches of more or less natural scenery, such as sloping banks, groves of trees, patches of shrubbery or the banks of rivers.

The ordinary public squares of a city are so well known that no special definition is necessary. The most usual, simplest, and in most cases, the most economical plan for such public squares is to grade the ground, build cross-walks and diagonal walks, plant rows of trees along the walks and have the remaining surface in nicely kept turf. A low fence, with gateways, but no gates, is a great aid to economical and neat maintenance. If expensive luxury of flower beds can be afforded, trees can not be permitted where they would shade them, and it is essential to good taste not only that the flower beds should be systematically and formally laid out and carefully designed in detail, but that the utmost neatness and substantiality should characterize the walks and other constructions, and that the turf should be everywhere perfect, and that the trees be symmetrical and well developed. If the expense of constructing and maintaining the square in this way can not be afforded, it is in the worst possible taste to attempt any flower gardening. In case there is a large poor population about the public square, it is important to provide ample accommodation for rough-and-tumble play, and it is well in such cases to finish a portion of the ground with a hard gravel surface, as it is impossible properly to maintain turf playgrounds. Provision should be made in such places, more often than is usually the case, for sand courts for very little children, swings and other apparatus for larger children and shelter and toilet accommodations. The public squares of a city afford the most appropriate sites for most portrait statues and public monuments, and in designing for such squares the object of providing suitable sites for such statues should be

constantly kept in mind. Sculptured fountains, with stone-curbed basins and other decorations, are also entirely appropriate, but cheap cast-iron fountains are abominations, which ought not to be permitted under any circumstances.

By the term "local parks" or "city parks," we designate those comparatively small parks surrounded by buildings, or which soon will be, having somewhat natural landscape effects, but so smooth and neat as to be obviously the work of man, lacking in perfect seclusion from city sights and sounds, and more or less decorated with flower beds, fountains, ornamental buildings and the like. Local parks are usually one hundred acres or more in extent, but may be smaller or larger, the size being less characteristic than the style in which they are improved and kept. Local parks are often more stiff and smooth and artificialized than is desirable, owing chiefly to the lack of appreciation of broad, simple landscape, natural scenery and native plants on the part of those who design, construct and care for them.

It would be more interesting and refreshing, by way of contrast with city streets and gardens, if the trees planted in local parks were less uniform in kind and appearance, less like trees; if the slopes were more gentle and natural than is often the case; if the ponds had gently sloping shores, more mystery and intricacy of water-loving plants, marginal shrubbery and groups of trees; if what purport to be natural lawns were kept free from stiff beds of flowers, dropped here and there without regard to general landscape effect or good design of any sort; and if the surrounding houses were, at least, partially screened by border plantations of trees and shrubbery. Owing to their situation and restricted size, and to the necessity for accommodating people in such a way as to reduce the wear upon turf and plantations to a minimum, the walks and other artificial construction must necessarily be disproportionately large, and often unduly conspicuous, but care should be taken both in the designing and in the grading and planting, to render all artificial constructions as subordinate as possible to the general effect of verdure.

It must be acknowledged that most people resort to local parks for more active and positive sorts of amusement than the enjoyment of natural scenery, and that suitable artificial provisions have

to be made for such amusements, so that the general aspect of local parks is inevitably less broad, simple and natural than outlying rural parks. For this reason, it is not inappropriate that the plantations in local parks should include many sorts of trees and shrubs which are not indigenous, and that more attention should be paid to striking effects in foliage and flowers than is proper in rural parks. It is also important, for the same reason, that a much neater method of care taking should be pursued than is necessary, or altogether appropriate, in the case of large rural parks; that is to say, any shabbiness, weediness or unevenness of the turf surface, any litter of fallen leaves or accumulation of scum on ponds, formed by decaying vegetable matter, should be avoided. In short, local parks may, perhaps, be designated "landscape gardens" to distinguish them from formal gardens or formal public squares on one hand, and from rural parks, with but little evidence of the gardener's care, on the other hand.

What we call "rural parks" are almost necessarily much larger than local parks. Their essential quality consists in the marked predominance of natural scenery, rurality and rusticity, and the relative inconspicuousness of the artificial features necessary for comfort and convenience, and their strict subordination to the landscape. The prime considerations in choosing sites and planning rural parks are breadth and seclusion, and contrast with the formality of the streets and gardens of the city. Every effort should be made to secure as perfect seclusion as possible from the sights and sounds of the city, while bringing the park as close to the city as practicable. Those who have traveled in England and have seen such deer parks as Windsor Park, Thoresby Park, Stoneleigh Abbey and other old deer parks and appreciated their simple beauty of rolling turf land, with great, broad-spreading oaks and beeches and elms irregularly and openly dispersed, will have seen one of the finest ideals for a municipal rural park.

Nearer home we have the oldest parts of Druid Hill Park, at Baltimore; the main central meadow of Prospect Park, in Brooklyn; the meadow in Washington Park, Chicago, as types of the sort of pastoral scenery which is best adapted for the enjoyment of large numbers of people. Woodland scenery, though very enjoyable if kept in a wild, natural state, is but poorly adapted to the use of

large numbers of people when they are allowed to picnic or stroll about on it at will, because, owing to the deep shade, it is impossible to maintain turf or other verdures on the surface of the ground, and if frequently trodden upon the ground becomes desolate, disorderly and disagreeable to the eye, and the trees almost inevitably die gradually from the trampling of the earth into a hard, pavement-like surface, which sheds nearly all rain and excludes the air from the soil, which is necessary for the healthy growth of the roots. Picnic groves must, therefore, be open enough to permit the grass to grow, and even then their use must be carefully regulated and restricted. Water, either in ponds or rivers, adds greatly to the interest of the landscape, and affords desirable opportunities for amusement. It is, therefore, important to choose the site for a rural park where an ample supply of water is available.

It is worth noting that very nearly all landscape gardeners, or those who have executed works of landscape gardening, both in this country and abroad (if one may safely judge by their work), have given comparatively little thought to the adaptation of the design to the natural scenery. Their works indicate that they were almost entirely occupied in creating a series of rather artificial little effects, and in securing as many interesting and beautiful objects as means of amusement as the space and pecuniary considerations would allow, with apparently no idea of subordinating all such things to a controlling, comprehensive and harmonious general design, in which natural landscape is the essential characteristic.

We need say little as to the large public grounds which we have referred to as "public reservations." Such reservations cover thousands of acres, and include ranges of hills and other natural landscape features of considerable extent. The principal object in preserving large areas of natural scenery for the enjoyment of the public is to secure, in a greater degree than is possible in the ordinary municipal rural park, opportunities for enjoying natural scenery of a wider and less sophisticated character than could be maintained in less extensive public grounds, and for roaming at will through woods and over hills and valleys.

The subject of parkways is, perhaps, of more direct interest than that of great parks to a large number of people who are looking for enhanced value in real estate, as well as for the opportunities for

pleasure driving and for agreeable building sites. As a parkway affords, almost invariably, continuous, double frontages as valuable for building sites, and in all respects as well adapted to the purpose as any public street, a similar method of assessing the cost of the improvement upon adjoining property owners ought to be pursued rather than to pay the whole cost out of the general tax levy. There should be a reasonable limit to such an assessment, which may, roughly speaking, be considered to be so much of the cost as will correspond with the cost of an avenue from one hundred to two hundred feet wide.

Beyond this limit it is proper that the cost should be paid partly by assessment of property within a quarter of a mile or more, which may be assumed to be benefited in the same manner as it would be by the laying out of a public square or local park, and partly by being charged to the general tax levy as expressing the benefit which a parkway broader than any avenue would be to the city as a whole as a pleasure drive and landscape feature of interest to all. If such a parkway can be laid out so as to include the banks of a river, creek or brook which serves as a storm outlet, a large expense for walls, and, possibly, covered channels, can often be saved the city by preserving the waterway, as sufficient space can thus be secured to permit the banks adjoining to be sloped off gently and preserved from damage by floods by means of turf or close growths of bushes.

The Muddy river improvement of Boston is an example of this sort of parkway. This principle of preserving the streams in parkways has been carefully worked out for one of our large suburban towns by its city engineer, who proves that, from an engineer's point of view alone, it will pay to preserve all the principal streams in parkways rather than to make walled ditches and channels for them from time to time. It is also to be noted that in laying out a parkway along a river or watercourse it is often possible to widen out the boundaries to such an extent as to provide valuable local pleasure grounds, which are not only worth more from thus being made part of a continuous parkway, but usually thus cost less both for land and improvement than if separate from the parkway.

PAVING OF COUNTRY HIGHWAYS.

By Capt. W. S. Williams.

THE paving of public highways is a question of importance which must be solved in the near future. We have a young and growing country just starting in business, as it were, without many of the conveniences of some of the older progressive countries of Europe. These conveniences will be secured in the course of time and as rapidly as possible. We have this advantage—we can learn from their experience, so that we may reject that which is not good. That our country highways must be paved is a fixed fact, and it is only a question of how soon it will be done; therefore, we must find which is the cheapest, the most lasting and the best.

If a country town or village would pave say ten miles each way towards the cardinal points of the compass, it would insure a regular wholesome trade the entire year to the town that has the pavements. And a farm situated at a distance of ten miles would be practically as valuable as one at two miles. A load of hay can be moved over a smooth paved roadway a distance of ten miles with much more conveniece and much less expenditure of energy than a distance of two miles through the mud.

There are two kinds of material in use for road pavements both in this country and Europe—brick and stone.

The Western Reserve and Maumee road built by the government, starting at Fort Croghan on the Sandusky river (now Fremont, O.), and extending to Fort Meigs on the Maumee river near Perrysburg, was afterwards continued from Fremont to Bellevue. This road has better gradients for its length perhaps than any in this or any other country. The road bed proper was thrown up about three feet in height. A very thick coating of broken stone was then placed upon the road, excepting that part between Fremont and Bellevue which was constructed mostly of gravel. Numerous toll-gates were established as a means of revenue for repairs of the road. Having charge of this road for quite a number of years as state engineer, the following facts were made manifest to me: That it did not wear well; that it would cut into numerous wheel ruts when wet, and when dry, the wheels would pulverize the stone and be blown away in the form of dust. When repaired, the rough broken stones were

objectionable until worn smooth, and further, it was a very expensive road to keep in order, the revenues scarcely being sufficient for the purpose.

The Netherlands seem to have the best and most lasting of paved highways extending through their country in various directions, reaching from city to city without regard to distance. The paving has been done so long ago that there are very few of the present generation who know when it was done. The material used was brick, known as the Dutch clinker. It is similar to our shale brick, but not as good as our best quality of shale. The repairs are very small. One man will keep several miles of this pavement in good order. It is apparent from experiments with different kinds of paved roadways that brick is the smoothest, most lasting, the cheapest and the best.

In many parts of the country the alluvial formation of mixed gravel, sand and sandy loam is sufficient. Sometimes it may be necessary to add more sand or gravel if convenient. Cinders or anything which water can pass through readily will do just as well as broken stone. It is not necessary to fill the interstices between the brick with coal tar. The brick, with a plain sand filler or its equivalent, will soon form a cement around and under the brick that will be impervious to water, and will become very tough and hard.

The road bed should be thrown up with sufficient crown so as to shed water nicely, and should then be rolled with a heavy roller, the heavier the better. The ramming and pounding should be done on the foundation and not on top of the brick.

A dirt or summer road adjacent to the paved way should always be maintained.

A gentleman from one of the back townships standing on a street corner in Nashville, Tenn., taking observations of an electric street car, give vent to his feelings as follows: "Wall, now, I'll declarr, them Yanks come down heyarr and they freed all our niggers. Heyarr they ar agin and they dun freed all our meules. I wonder what they'r gwyne to free next."

The day is not far distant when the motor will be brought into general use, driven by various forms of energy, propelling road wagons, farming appliance, etc. A large number of our horses can be relieved and the energy that was used to propel them in the

shape of hay and grain can be put into roast beef or other places where it will do the most good.

Paved streets and highways indicate the work of an industrious, prosperous and intelligent people. It is immaterial whether we find it upon the Appian way at Rome, left as a mark of former greatness, or on highways leading down to and under the sea, submerged by earthquakes ages ago, extending from large ruined cities, now overgrown by the deep tropical forest growth of Yucatan. The paved highways remain as a lasting monument to the intelligence of an unknown people.

CAPT. W. S. WILLIAMS was born in Canton, Ohio, in 1835. His mother was of Huguenot and his father of Scotch-Irish descent. As a boy he was employed about his father's farm and brickyard. During the war he commanded what was the well-known "Williams' Battery," and was chief of artillery of Gen. Logan's division, and participated in about all of the hard service of Gen. Grant's old army. Upon his return home, he was engaged in civil engineering, and for a number of years was engineer of public works, state of Ohio, and inspector of railroads. One of the first plants expressly for the purpose of manufacturing street paving brick in the United States was erected by him, and the first shipment of shale brick was made to L. M. Southern, a large real estate dealer in Cleveland, Ohio.

SEWAGE DISPOSAL IN ENGLAND.

*By Allen Hazen.**

THE countries of western and central Europe have a denser population than in the greater part of the United States, and although their cities are growing, in many cases almost as rapidly as ours, there have been for many years in Europe, centers of population which compelled attention to various sanitary questions long before corresponding issues were raised in the United States, and processes of sewage purification have been in common use in Europe, particularly in England, for the last quarter of a century, which

*Condensed from a paper read before the Boston Society of Civil Engineers.

are just beginning to be seriously considered and adopted in the United States.

It is, of course, true that a certain amount of work, particularly experimental work, has been done in the United States which is of as high a grade as that which has been done anywhere, and some of the information which has been secured in America in regard to sewage purification processes, and the disposal of sewage by dilution in streams and lakes, is of great value to us, and could not be replaced by any amount of European experience obtained under other conditions of climate and geology; but, on the other hand, the continued experience of European cities for a long series of years with many of the problems which are now seriously confronting American cities has resulted in the accumulation of a fund of information which deserves to be most carefully studied by all who would be proficient in the art and science of sewage disposal.

There are in reality two sewage disposal problems which are radically different from each other in their natures and which present themselves in different cases. The first of these is the case of the discharge of sewage into bodies of water, either lakes or rivers, from which water is taken for domestic supply from points which may be reached by the discharged sewage. The problem presented in this case is to so completely purify the sewage that when mixed with the water it will not be injurious to health. Years ago, before the germ theory of disease was established, the possibility of purifying sewage in this way would hardly have been admitted, but, thanks to the more recent German and English investigations, as well as to the experiments of our own (Massachusetts) State Board of Health, it is now well known that it is entirely possible to accomplish this through the wonderful purifying power of sandy soils under proper conditions; and it is actually a fact that the effluents from certain European sewage works, as well as from some of the purification fields in Massachusetts, are preferable, from a hygienic standpoint, to the public supplies of a number of large American cities.

The second problem in sewage purification is that of so purifying sewage that it will not cause a nuisance in the water into which it flows. When a small quantity of sewage is discharged into a large volume of pure, or comparatively pure water, the organic and

polluting matters of the sewage are oxidized and destroyed by the oxygen of the air which is ordinarily contained in solution in the water into which the sewage is discharged. In case, however, the quantity of sewage becomes greater than can be oxidized at once by this oxygen, the last part of the decomposition of the organic matters takes place in the absence of air, and with the formation of products which are given off into the air causing objectionable odors, and the whole body of the liquid becomes foul. The condition becomes still worse when the water is still, or has so low a velocity that it allows the heavier matters from the sewage to be deposited upon the bottom, where they accumulate as masses of mud which decompose with the most objectionable results. This condition of affairs may often result, even though the quantity of sewage is not great enough to render the whole body of the water offensive, and is thus likely to occur in sluggish streams which would otherwise remove the sewage without nuisance.

It is undoubtedly a fact that sewage has been purified much more frequently to prevent the production of a nuisance of this kind than to protect the purity of drinking water supplies, perhaps because a black dirty stream, giving off sulphureted hydrogen gas, is more obviously a nuisance than is a polluted water supply, the relation of which to the health of the community is too often but imperfectly realized even by those having such matters in direct charge, and much less by the mass of voters and tax-payers whose support must be obtained before any expensive improvements are possible.

The processes which are used for purifying sewage may be divided into two general classes: land treatment and chemical processes, although a combination of both of them is frequently used. The principles involved in purifying sewage by applying it to land are essentially the same, whether it is applied to soils and loams at a very low rate and with a growth of crops under the name of "broad irrigation," or whether it is applied to specially prepared areas of favorable materials at much higher rates under the name of "intermitting filtrations;" and even the filtration at very high rates with forced ventilation, which has recently been proposed, but has not as yet been carried out on a large scale, involves exactly the same principles.

The other class of processes are those which by chemical and

mechanical means attempt to remove from the sewage in concentrate form a portion of its impurities, and although the number of processes which might be included in this general definition is very great, none of them have achieved practical success except such as can properly be called "chemical precipitation."

One of the most interesting cases where sewage is purified to prevent the pollution of public water supplies, is furnished by the cities and towns upon the watersheds from which the water supply of London is drawn. Conservancy boards have control of the rivers, and it is their duty to see that they are not polluted so as to affect the quality of the water supplies drawn from them, or become otherwise injurious to the people upon their banks. The Conservancy Board of the River Thames has control of the main river for its whole length, and of its tributaries within ten miles of the main river measured in a straight line, but curiously enough, it has no control of the tributaries beyond that distance. The conservators of the River Lea have control of the entire watershed.

There are thirty-nine places upon these two rivers which are giving their sewage systematic treatment, and, so far as known, no crude sewage is ordinarily discharged into the rivers at any point. Of these thirty-nine places, thirty-eight treat their sewage by applying it to land, while one of the smaller places, Hertford, uses chemical precipitation. The conservators do not regard the chemical precipitation as satisfactory, and have recently conducted an expensive lawsuit against the local authorities to compel them to further treat their effluent, but this suit was lost, as the court held that no actual injury to health had been shown. It is worth noticing, however, that the water into which the effluent is discharged is all carefully filtered before it is delivered to consumers.

The conservators require, where land treatment is used, that sufficient area shall be provided to allow all of the sewage to percolate through it in ordinary weather, and they strongly object to allowing any sewage to flow over the surface of the land into the streams. The land used for this purpose, however, is, as a rule, much less porous than the land commonly used for sewage treatment on continental Europe and in this country; and at times of heavy storms there is often as much water from the rain alone as the land can take without becoming unduly flooded, and it is then

incapable of receiving even the ordinary quantity of sewage, and much less the storm flow, as the sewers are generally, if not always, on the combined system. At such times, the sewage either flows over the surface of the land with the very inadeqate purification due to the retention of solid matter in the grass and osiers, or perhaps more frequently it is discharged directly into the rivers without even a pretense of treatment. The conservators apparently regard this as an unavoidable evil and do not vigorously oppose it, as it is their theory that at these times the increased dilution with the high water in the rivers is such that there is no great danger from the sewage, although it would seem that the increased velocity and consequent reduction in time for the matters to reach the water-works intakes would, in a large measure, counterbalance the increased dilution.

The water companies are expected to have so much storage capacity for unfiltered water that they will not be obliged to take in water at times of flood; but as a matter of fact, it is believed that they often do take in water at these times, although no records are kept either of the times when water is taken in, or of the times when the sewage is discharged without treatment. This is one of the cases which one so often finds in England and elsewhere, where it is regarded as safer to have no information than to keep records. It should be said, however, that no evidence has been found that the health of the inhabitants of London is in any way affected by this discharge of sewage into the water courses from which their water is drawn; but this favorable condition is believed to be largely due to the great care with which all of the water is filtered.

The cases of the other class where sewage is purified to prevent its becoming a nuisance, but without regard to possible pollutions of water supplies, are very numerous. Many years ago England took the lead in works of this nature, and has at the present time probably a larger number of works than are to be found in all the rest of the world.

England has a very dense population, but it is far from being equally distributed over its entire area. Near the southeast corner, on the tidal estuary of the Thames, is that enormous aggregate of population known as "Greater London;" and in central England, directly back of England's greatest harbor, Liverpool, is a small

area which has become perhaps the most densely populated of any region of its size on the face of the earth, due to the harbor and to the deposits of coal and iron ore which there occur. Within a distance of forty miles from Manchester are Liverpool, Salford, Bolton, Preston, Oldham, Blackburn, Huddersfield, Birkenhead, Leeds and Sheffield, all of them great cities, and a hundred smaller places which so completely fill the intervening spaces that parts of the region have almost the aspect of one great extended city. A large part of the area is a broken, hilly country, with steep, although not high hillsides, between which are narrow valleys in which are the railroads, mines and factories. The rivers, as they are called, are but short streams rising in the hills immediately back of the cities, and many of them would hardly be dignified with the name of river in this country.

With the great development of manufacturing, the sewage and wastes were at first discharged directly into the streams until they became excessively foul, and the sewage problem was forced upon them in perhaps its most difficult form. There were but limited areas of land in the valleys with elevations which would allow their use for sewage purification, and even these areas were often occupied by mills, or held at high prices in expectation of such use, and the land itself was, as a rule, compact, impervious and but poorly adapted to sewage purification. The conditions in this region were probably more favorable for chemical precipitation, as against land treatment, than at almost any other place, and chemical precipitation has been the most commonly used method of treatment, Leeds, Sheffield, Bradford, Manchester, Salford and Huddersfield among the larger places using it. Chemical precipitation, however, although great improvements have been made in the form of settling tanks and in the methods of managing them, removes scarcely more than one-half of the organic matters in the sewage and never more than two-thirds, and the effluents generally carry on an average from two to five parts per hundred thousand of suspended matters capable of forming deposits in the streams; and it has been found that effluents purified to only this extent are very apt to produce more or less trouble when discharged into such small streams as exist in this region, and it is becoming more and more apparent that some

more thorough process will be required before the problem can fairly be considered solved.

Already much has been done in this direction. At Sheffield the effluent is taken through coke filters at a very high rate, and a portion of the suspended matters in the effluent is thus removed, although the purification obtained is far from what might be desired. This use of coke for filtering material has this strong point in its favor, that when the coke becomes dirty it can be burned with the matters accumulated in it under the boilers that are sure to be in use at the works. At Huddersfield, the effluent is filtered through sand and patented substance called "polarite," with the result that most of the suspended matters are removed, although the dissolved organic matters hardly have time to become oxidized with the rapid filtration employed.

At Bradford and at Salford experiments have been made on a considerable scale with rapid filtration through sand or coke, and forced aeration has also been experimented with in the endeaver to find a process which is at once very rapid and capable of yielding effluents comparable in purity to those obtained from land treatments. This question of further purification for chemical precipitation effluents is now being everywhere discussed, and experimental filters are to be found with a surprising frequency, and we may confidently expect that the coming years will witness great changes in the methods of sewage treatment in this locality.

A little to the south of the Manchester district is Birmingham, a great manufacturing city, which treats its sewage first by chemical precipitation, and afterwards applies the effluent to a large area of meadow land on both sides of the small river into which it eventually finds its way. Leicester, a few miles to the east, uses substantially the same process.

At London the sewers from a large metropolitan district have been gradually combined into one great system, or rather two systems, one for the north and one for the south side of the River Thames, both of which are administered by the London county council. The conditions here are in many respects different from those of almost any other large city. The sewage is carried down by intercepting sewers to points some miles below the city, and is discharged into the estuary where there are very powerful tidal

currents in addition to the natural flow of fresh water from the river. Formerly the sewage was discharged without treatment at these points, but it caused so great a nuisance in the river, both to the shipping and to the residents upon the banks of the river, both below and above the points of discharge, that in the last years works have been built to treat the whole of it by chemical precipitation, except the storm overflows.

Although London is noted for its rainy weather, it seldom rains rapidly there, and the precipitation is more apt to come in the form of a slow drizzle, which the sewers are capable of removing, and the sewage which goes to the river through the overflows is much less than would be the case in an American climate. Mr. Santo Crimp, formerly in charge of the London Sewerage Works, has estimated that in the aggregate only about 4 per cent. of the sewage is discharged untreated into the river, the remaining 96 per cent. being treated before its discharge.

On Continental Europe the conditions for land treatment are, as a rule, more favorable than is the case in England, and chemical precipitation has gained but a slight foothold, only one large city, Frankfort-on-Main in Germany, employing it, although it is used at a considerable number of smaller places and is being considered at Leipsic.

In the early days of chemical precipitation lime was commonly employed as a precipitant, and where the sewage contains a large amount of iron and acid from wire works, as is the case at Leeds, Sheffield and Birmingham, lime answers as well or better than any other precipitant, but in other cases it has little to recommend it, and has usually been superseded either by copperas or by sulphate of alumina, although it is necessary to use with each of them a small quantity of lime to insure rapid precipitation. At London copperas is employed, while other English cities have varied their precipitants from time to time.

One of the serious problems connected with chemical precipitation of sewage is the disposal of sludge, and in selecting the precipitant it is necessary to consider not only the purity of the effluent which can be obtained, but also the quantity and character of the sludge produced by it. At London several tank ships are employed which carry the sludge out to sea, each ship making two

trips daily, and carrying about one thousand tons, of which 90 per cent. is moisture. To reduce the sludge to as small a volume as possible, it is pumped from the settling tanks into another set of smaller tanks and is settled over again, reducing it to one-third of its original volume. From these the supernatant liquid flows back into the incoming sewage to be treated over again, and the remaining sludge is run into the tank ships. These ships are of steel and have air chambers in their bottoms to give them sufficient buoyancy so that the sludge will flow out through the openings in their bottoms when they reach the point of discharge, fifty miles from the works.

At Birmingham the sludge is run upon and dug into several hundred acres of land with fairly good results. At Sheffield and other places it is simply piled up on unused land, and given away for a fertilizer when possible, and by sprinkling it with lime and with chloride of lime in summer, it does not become an unbearable nuisance, although this practice can hardly be recommended. Manchester and Salford have hoped to carry their sewage out to sea, as is done at London by means of the Manchester ship canal, but I do not know that they have yet commenced to do so.

Huddersfield and many of the newer works press the sludge in filter presses to solid cakes which can be easily handled, and which can be applied to land or stored without creating a nuisance. The putrefaction, which makes sewage and sludge offensive, seems to require the presence of an excess of moisture, and when the moisture is absent, as in pressed sludge and in land used for sewage treatment, this putrefaction did not occur, but the changes which take place are of an inoffensive nature. The cost of pressing is considerable, and it is this which probably prevents it from being more generally adopted.

The shape of the settling tanks for chemical precipitation has been changed somewhat in the course of years. The earlier tanks were nearly square and were often used intermittingly, being filled with sewage, allowed to stand and afterwards emptied and then filled up again. This was known as the intermittent process and has been almost everywhere abandoned, although still in use at Sheffield. In the continuous process, now generally used, the tanks are connected with each other, and the treated sewage is run

into a series of them, passing from one to another until finally it is discharged. The newer works, however, as a rule, consist of long narrow tanks so arranged that a portion of the treated sewage passes through each of them, and is then discharged, so that each tank is entirely independent of the others. These tanks are ordinarily from thirty to sixty feet wide, but are occasionally much wider, and in length range from one to two hundred to six and ten hundred feet. The bottoms slope rapidly from each side to the middle, and the middle slopes slightly from the outlet end of the tank toward the inlet, and there is usually a sludge channel in the middle a foot lower than the bottom, to insure a rapid removal of the sludge when the tanks are cleaned. All of the earlier tanks were open to the sky, but in 1884 Lindley build precipitation tanks at Frankfort covered with a vaulting with soil above, laid out as a garden. This arrangement prevents any possible interference with the sedimentation by the wind or by ice, and also makes a much more attractive appearing place than the open tanks.

The settling tanks at London are also vaulted. On the north side of the river the tanks are only thirty-two feet wide, and there is an arched spandrel wall half way between the sides, and the roof is made of two continuous arches covered with earth and with manholes to furnish light. It is stated that it was quite as cheap to build the tanks in this way as it would have been to build them open, because the walls between the tanks, being supported at the top, are very much thinner than would have been necessary with open tanks, and the excavated material was placed above the vaulting without expense for removing it, and the economies thus affected fully equaled the cost of the vaulting. The more recently constructed settling tanks on the south side of the river are of the same general construction, but the manholes were omitted, and it is found that there was both a great saving in the cost of construction, and the work of cleaning the tanks can be better done by artificial light throughout than by the very irregular light admitted through manholes.

Vertical settling tanks like those used at the World's Columbian Exposition at Chicago are occasionally used in Germany, particularly in small places, and are in some respects convenient, although the sedimentation is probably less complete than is the

case with properly constructed horizontal tanks. The famous tanks at Dortmund are being replaced by broad irrigation.

In other parts of England, where the population is much less dense than in the districts mentioned and where land for sewage treatment is more easily secured, chemical precipitation works are the exception rather than the rule, and sewage farming is generally employed where sewage requires to be treated.

MECHANICAL ANALYSES OF SAMPLES OF MATERIALS FROM CERTAIN EUROPEAN AND AMERICAN SEWAGE FARMS.

COLLECTED BY THE AUTHOR.

(For methods of analyses see Report of Massachusetts State Board of Health for 1892, page 541.)

Location.	Description of Samples.	Effective Size, 10 per cent. finer than: (Millimeters).	Uniformity Coefficient.	Albuminoid Ammonia, Parts in 100,000 by weight.
Berlin, Malchow Farm.	Surface soil where it had recently been ploughed.	0.12	5.6	34.
" "	Subsoil two feet deep at same place.	0.12	3.4	33.
" "	Surface soil not recently ploughed.	0.12	2.2	90.
" "	Subsoil two feet deep at same place.	0.13	2.7	31.
Berlin, Grossbeeren Farm.	Surface soil in actual use.	0.15	2.0	26.
" "	From a sand bank near by representing the original unused material.	0.15	1.8	1.
Breslau.	Subsoil one foot below surface of sewage field in use.	0.24	1.9	2.
Paris.	Surface soil from sewage fields in use.	0.13	5.9	64.
Framingham, Mass.	Sand from sewage filters.	0.35 to 0.42	4. to 5.	
Marlborough, Mass.	" " " "	0.12	3. to 4	
Gardner, Mass.	" " " "	0.10 to 0.24	6. to 14.	
Brockton, Mass.	" " " "	0.30 to 0.60	2. to 5.	
Poughkeepsie, N. Y.	Sand from sewage filters at Vassar College.	0.10 to 0.50	2. to 5.	0. to 2.
Plainfield, N. J.	Sand from sewage filters.	0.10 to 0 25	2. to 5.	0. to 3.
Pullman, Ill.	Soil from sewage farm.	0.01	15.	225.

In conclusion, the trend of the best European practice in sewage disposal is strongly toward the treatment or purification of sewage in all cases before it is discharged into rivers, with the exception of very large rivers, and at points where there are strong tidal currents.

CEMENT AND ITS USE.

DETAILS OF THE SIMPLER TESTS OF CEMENT.

By L. C. Sabin, Assoc. M. Am. Soc. C. E.

V. STRENGTH.

We have now considered three important tests of cement, and have shown that they require only such simple apparatus as may readily be obtained. It is usually considered that an expensive apparatus is requisite for the tests for strength, and since this test is frequently thought to be the only one of importance, tests are neglected entirely rather than to incur the expense and trouble of making this one. As a matter of fact the tests for strength as usually carried out is not of greater value than the tests of soundness, fineness and specific gravity, though in connection with these three tests a knowledge of the strength of the cement is of assistance in pronouncing upon the quality of the sample.

There are methods of obtaining approximate results in tests of strength by means of simple home-made apparatus, but the accuracy of results so obtained should not be overestimated.

The strength of cement is generally tested by applying tensile stress to a briquet made of cement and water, or of cement, sand and water. This tensile test of cohesion has met with favor, because, with proper apparatus, it is very readily made. Tests of adhesion, abrasion, compression, etc., have been used to a limited extent, but in all of these there is either some greater difficulty introduced in preparing the specimens and obtaining uniform results, or the results, when obtained, are difficult of interpretation.

The transverse test offers an easy means of obtaining an approximate idea of strength, and this method will be briefly described here. Specimens eight inches long and having a cross section two inches square, may well be used. The molds for preparing these specimens may be of hard wood, though metal molds are, of course, preferable. The mortar should be mixed with a hoe, and a deep narrow box with sloping bottom will be convenient for the purpose. The proportions of cement and sand should be carefully weighed, and the water measured in a glass graduate. The greatest care is necessary concerning the amount of water added. It is probable that variations in the consistency of the mortar are accountable for more discrepancies in results than any other single cause. The mortar should be capable of being easily molded into a ball in the hands, and when dropped from a height of one and one-half feet, on a hard slab, this ball should retain its rounded form without cracking. The mortar should also leave a trowel clean when allowed to drop from it.

Were a smaller amount of water used the mortar would be crumbly, and the ball would crack when dropped on the slab, while a larger amount of water would cause the mortar to adhere to the trowel, and the ball would be flattened by striking the slab.

Another important point is that the mixture should be thoroughly gauged, and one will soon come to

know when this part of the work is well done by the peculiar plasticity which is given to the mortar. The molds should be oiled with a mixture of lard oil and kerosene before use.

If one does not care to compare his results with those of other experimenters (and this is practically out of the question with the crude tests now being described), it makes little difference how much packing the mortar is subjected to in placing it in the molds, so long as the same pressure is used for all the samples made. The mortar should be pressed firmly into the molds with the fingers, and smoothed off with a trowel, and the specimens afterward kept in a damp place for twenty-four hours and immersed in water after removing from the molds.

At the end of seven days, or better, twenty-eight days if so much time is allowable, the specimens may be broken by placing them across knife edges and hanging a weight at the center by means of a third knife edge. For this purpose one may use very crude appliances if only a few specimens are to be broken. Prepare two blocks of wood with a triangular trough cut in each. Lay pieces of one-half inch or one inch square bar iron in these in such a way that one edge of the bar projects above the surface of the block, forming a knife edge. Supporting these blocks on "horses," so that the knife edges are five and one-third inches apart, lay the specimen across them. A third knife edge or a bolt may be placed across the center from which to hang a pail. By allowing water to run into the pail slowly the stress is applied.

For strong specimens it will be found necessary to replace the pail with a platform which may be loaded with stone. A better arrangement may readily be devised in the form of a lever, the pail into which the water is run hanging at the end of the longer arm, the weight being multiplied as many times as desired. The reason for selecting five and one-third inches as the span is that, for a two-inch square bar, the modulus of rupture computed by the formula $f=\frac{3wl}{2bd^2}$ is numerically equal to the center load.

No attempt has here been made to go into the details of making accurate tests of strength, since such tests are too difficult to come under the scope of this series of articles. The care required as to proportion, temperatures, manipulation, etc., have only been hinted at. For careful tests of strength the tensile tests is preferable to the transverse for reasons which need not be mentioned here, but as a crude test, to give a general idea of strength, one may make a transverse test with the simplest apparatus.

In closing this series of articles the writer would again warn the beginner not to expect his results to compare closely with those obtained by other experimenters, and he would also urge the advisability of keeping on hand several samples of standard brands with which to compare the cements under examination.

ANALYSIS AND TESTS OF MATERIALS BY CEMENT MANUFACTURERS.

To the Editor of Paving and Municipal Engineering.

I note in your February issue, an extract of a paper written by Mr. H. F. Gray, M. Institute Civil Engineers, engineer in charge of public works, in Canada, in which he recommends and strongly advises to "have the raw material of a cement chemically and properly analyzed *before* being roasted and

ground." He writes a number of reasons in favor of this method, and instances the analysis of iron and steel as one of them.

On behalf of one of the largest producers of American Portland cement, I only desire to say that all the raw material from the manufacture of Portland cement at our works, is analyzed as it is blasted from the quarries, and it is subsequently analyzed when it is mixed together as "composition" for the purpose of manufacturing Portland cement. Without such analysis, it would be impossible for us or any other manufacturer to determine the kind of cement that would be produced, or the temperature at which calcination should take place. The practice above referred to, I understand, prevails in all the American works, and in the great bulk of the foreign works, and the tests of the manufactured cements are only conformatory of the analytical tests, and prove that the cement made of the previously analyzed raw materials is of the kind that those particular raw materials, with those particular raw ingredients, should, under proper methods, properly produce.

R. M. LESLEY.

PHILADELPHIA, February 7, 1896.

PROPER CONSISTENCY OF CONCRETE AFTER MIXING.

Mr. C. K. Mohler suggests that allowance must be made for the fact in the handling of concrete that the average workman regards and treats it only as so much mud. To bring the film to the surface there is likely to be excessive ramming. "With a quick-setting cement," he says, "this may not be accomplished before the concrete has begun to set. The greatest danger, however, lies in the possibility, or rather probability, of breaking the bond of the concrete below. By the use of a 30 to 35 pound rammer (as specified in Prof. J. B. Johnson's 'Engineering Contracts and Specifications'), on an imperfect cushion of 'dry' concrete, you are almost certain to accomplish the destruction of the bond in the course beneath. By the use of the 'quaking liver' concrete it can be placed, compacted and smoothed off at once with a shovel. Or if a rammer is used, it should be broad and very light. Another objection to the dry concrete is the 'ragged edge' of dry stone where the concrete is mixed and placed in batches. It is impossible to get a bond with the edge of the preceding batch, without ramming, thereby disturbing that which has taken a partial set."

THE CEMENT INDUSTRY IN AMERICA.

According to the newly published report of the United States Geological Survey on mineral resources, the production of Portland cement in this country during the year 1894 reached a total of 798,757 barrels, as compared with 590,652 barrels in the previous year, an increase of 208,105 barrels, or 35 per cent. The increase was generally distributed through the country. It is attributed in part to the establishment of new factories, of which twenty-four were in operation in 1894 as compared with nineteen in 1893. The largest increase, however, was in the output of the older factories, notably in Lehigh county, Pa. The establishment of new works and the extension of older plants indicate a continued increase in the production.

While the domestic production increased, the importation of cement for 1894 slightly decreased. The following table shows the relative proportion of Portland cement

made in this country and imported during the last four years:

	1891.	1892.	1893.	1894.
	Barrels.	Barrels.	Barrels.	Barrels.
Production in the United States	454,813	547,440	590,652	798,757
Imports	2,988,313	2,440,654	2,674,149	2,638,107
Total	3,443,126	2,988,094	3,264,801	3,436,864
Exports	.....	21,586	14,276	9,725
Total consumption	3,443,126	2,966,568	3,250,525	3,427,139
Percentage of total consumption produced in the United States	13.2	18.4	18.2	23.3

The foregoing table shows that the importation of cement into this country has remained nearly stationary since 1891, and that the domestic production has gained rapidly until in 1894 nearly one-fourth of the Portland cement used was of American manufacture. The government report says that there is little doubt that this gain will continue, and that within a very few years practically all the Portland cement required in this country will be manufactured at home. It says further that the indications are that the capacity of American factories will be taxed to its utmost during the next few months, "as American Portland cement is to be had at 50 cents or $1 per barrel less than the best German, and is being extensively adopted for large government and private contracts. The battle between natural rock and Portland cement has been fought out in England and Germany, and has resulted in the complete victory of Portland and the practical disappearance of the natural rock industry. The result in this country can hardly be so decisive, as most of the natural rock cements produced here are certainly greatly superior to the Roman cements formerly made in Europe."

The following table shows the production of Portland cement by states in 1894:

States.	Number of works.	Product.	Value, not including barrels.
		Barrels.	
California	1	19,300	$43,425
Colorada	1	15,000	37,500
Dakota	1	43,500	80,475
Illinois	1	300	540
Indiana	1	4,000	7,200
New York	4	117,275	205,231
New Jersey	1	72,223	119,168
Ohio	4	80,653	144,425
Pennsylvania	7	437,106	718,009
Texas	1	8,000	24,000
Utah	2	1,400	3,500
Total	24	798,757	1,383,473

The importation of all classes of cement into the United States during the fiscal years 1893 and 1894, arranged by ports, is shown by the following table:

CEMENT.

Imports of cement, by ports, during the fiscal years ending June 30, 1893 and 1894.

Ports.	1893.		1894.	
	Pounds.	Value.	Pounds.	Value.
Atlantic coast.				
Aroostook, Me	6	$2	163,000	$653
Baltimore, Md	108,479,638	359,144	77,960,821	249,403
Bath, Me			8,400	34
Boston and Charlestown, Mass	61,168,395	206,783	62,972,160	188,534
Charleston, S. C	2,662,405	8,749	6,224,911	21,956
Georgetown, D. C	4,000	10	165,365	655
Newport News, Va			11,304,000	35,920
New York, N. Y	506,135,997	1,690,622	384,406,008	1,251,099
Passamaquoddy, Me	600	4		
Philadelphia, Pa	129,689,778	412,160	111,629,516	365,652
Portland and Falmouth, Me			1,699,600	5,248
Richmond, Va			295,000	915
Savannah, Ga	6,350,992	19,031	9,661,156	27,966
Wilmington, N. C	222,224	800		
Total	812,965,761	2,699,245	680,522,985	2,139,749
Gulf coast.				
Galveston, Tex	27,563,787	89,322	19,207,393	56,561
New Orleans, La	112,443,449	377,288	85,794,952	271,570
Pensacola, Fla	998,640	2,261	1,415,580	4,988
Tampa, Fla	266,600	1,225		
Total	141,732,016	477,096	106,417,924	336,256
Pacific coast.				
Los Angeles, Cal	11,027,183	36,668	6,656,446	21,637
Oregon, Oregon			500,000	1,277
Puget Sound, Wash	24,141,996	81,079	21,706,402	66,065
San Diego, Cal	22,744,180	79,970	14,761,600	45,802
San Francisco, Cal	82,641,656	279,479	175,809,312	533,394
Willamette, Oregon	14,632,225	49,746	47,560,964	155,122
Total	155,209,430	526,931	226,976,024	726,967
Lake.				
Buffalo Creek, N. Y	115	40		
Cape Vincent, N. Y	50,000	164	76,430	243
Champlain, N. Y	96,000	307		
Chicago, Ill	1,374,262	4,611	996,020	3,299
Cuyahoga, Ohio	63,000	126	134,000	402
Detroit, Mich	11,000	61	313,300	1,420
Huron, Mich			4,700	20
Miami, Ohio			412,500	1,750
Oswegatchie, N. Y	615,265	2,470	3,945	27
Oswego, N. Y	2,750	12	74,000	409
Total	2,302,692	8,087	2,074,561	7,359
Interior.				
Vermont	5,000	20	1,500	75
Cincinnati, Ohio	49,207	203		
Indianapolis, Ind			46,000	230
Kansas City, Mo	60,000	257	60,000	260
Louisville, Ky	296,138	1,046	230,000	810
St. Louis, Mo	12,223,701	47,701	14,877,677	52,997
Total	12,634,046	49,303	15,243,277	54,196
Grand total	1,124,844,545	3,760,664	1,031,233,873	3,265,067

Mr. Spencer B. Newberry, comments briefly on the materials used in making Portland cement—carbonate of lime and clay. "These materials," he says, "may be naturally mixed, as in the case of argillaceous limestone or entirely separate. In all cases, however, it is necessary to bring the material to correct composition by artificial conditions and thorough mixing. In England, chalk is the form of carbonate of lime employed. In Germany, the chief material is marl, by which is understood a more or less hard limestone rock containing clay. In some German factories a soft marl or fresh water chalk is used, consisting generally of carbonate of lime similar to the marl deposits of this country.

"In the United States, the materials used are very similar to those of Germany. Most of our clay limestones are highly magnesian, and, therefore, unsuitable for Portland cement, though they are used on an immense scale for natural rock cements. In certain localities, however, as in Lehigh county, Pa., at Phillipsburg, N. J., and in the far west, limestones containing sufficient clay and nearly free from magnesia are abundantly found, and from this material most of our Portland cement is made. In the Lehigh county region, the chief seat of the American Portland cement industry, the different strata of rock are carefully selected and mixed in such proportions as to give a material of the right composition.

"In central New York, and at a few points in Ohio and Indiana, large deposits of pure white marl are found. This is generally called shell marl, and is supposed to result from the disintegration of fresh water shells. In the opinion of the writer, however, these marl beds are generally pulverulent deposits from calcareous springs and are not formed from shells. At the localities above mentioned, this material, artificially mixed with clay, is largely used in the manufacture of Portland cement. Owing to the soft, fine-grained character of the marl, the mixing can be much more cheaply done than in the case of limestone, though this advantage is largely compensated for by the necessity of drying out the 40 to 50 per cent. of water which the marl generally contains."

There are seventeen American factories which make Portland cement from limestone and seven from marl.

The report briefly describes processes as follows: "There are four distinct forms of kilns used in burning Portland cement. These are (1) intermittent or dome kiln, (2) continuous kiln of the Deitzsch or Shofer type, (3) Hoffman ring furnace, (4) rotary furnace. In the old-fashioned intermittent kiln the bricks of cement mixture are charged into the kiln with coke in alternate layers, and the whole allowed to burn out and cool down before emptying. The Dietzsch or Shofer continuous kiln is continuously charged with bricks of cement mixture and soft coal, and the burned clinker periodically withdrawn at the bottom. It presents the great advantage of cheaper fuel and economy of labor. The Hoffman ring furnace consists of a number of chambers arranged around a central stack. These are filled with bricks of a cement mixture, and the fuel introduced through the openings in the top. This form of kiln is economical of fuel, but requires more labor than the other types of kiln. The Hoffman ring furnace is used in this country to some extent in burning

brick, sewer pipe and lime, but not, so far as the writer can learn, in the manufacture of cement. The rotary furnace has been fully described in previous reports. Crude or fuel oil is used as a source of heat at all points where this kiln is employed."

The statement is made that the output of rotary furnaces has increased much more rapidly than that of rotary kilns. "The recent rapid advance in the price of crude oil is a great obstacle to the use of the rotary furnace. Attempts are being made to substitute producer gas for crude oil in burning cement. There is no reason why this should not be successfully done, and the change will greatly reduce the cost of burning cement at points where the rotary process is used."

The report also shows a slight increase in the production of natural rock cement in 1894. In this industry the United States leads the world. Comparative statistics for 1893 and 1894 by states are as follows:

Product of hydraulic cement in 1893 and 1894.

States.	1893.			1894.		
	Number of works.	Barrels.	Value.	Number of works.	Barrels.	Value.
Georgia	1	10,272	27,123	1	2,100	27,000
Illinois	2	522,972	156,659	2	440,307	153,880
Indiana and Kentucky	10	1,730,450	825,105	10	2,000,000	600,000
Kansas	1	60,000	21,000	1	50,000	25,000
Maryland and West Virginia	5	931,500	139,584	4	270,000	136,250
Minnesota	1	70,000	17,500	1	62,750	31,045
New Mexico	1	1,040	1,125		Idle.	
New York:						
Ulster County	17	2,736,994	1,368,497	17	2,250,661	1,125,330
Erie County	4	973,000	267,540	4	778,000	269,601
Onondaga County	8	301,360	87,394	6	197,020	79,303
Schoharie County	1	22,500	14,000	1	20,000	11,000
Ohio	1	56,000	43,550	1	35,723	22,500
Pennsylvania	6	367,110	205,159	5	660,612	260,701
Texas	1	10,000	25,000	1	12,000	15,000
Utah	1	5,000	6,250		Idle.	
Virginia	1	17,000	10,707	2	14,000	8,700
Wisconsin	2	494,733	124,650	2	502,000	107,600
Total	66	7,413,015	3,354,797	67	7,980,073	3,035,731

Production of cement of all kinds in the United States since 1880.

Years.	Production.	Value.
	Barrels.	
1880	2,072,943	$1,052,707
1881	2,500,000	2,000,000
1882	3,250,000	3,672,750
1883	4,190,000	4,292,500
1884	4,000,000	3,720,000
1885	4,150,000	3,492,500
1886	4,500,000	3,960,000
1887	6,082,744	5,674,377
1888	5,503,295	5,021,139
1889	7,000,000	5,600,000
1890	8,000,000	6,000,000
1891	8,222,792	6,680,951
1892	8,756,021	7,182,750
1893	6,002,467	6,262,841
1894	8,302,245	5,030,081

The natural rock cements of America are far superior to those of other countries. The magnitude of the work done with this material in this country is very large, and the government report says that an instance of a failure has yet to be reported. More than one hundred million barrels of this cement have been used during the last twenty years.

ANSWERS TO QUESTIONS.

[By J. W. Howard, B. L., C. E., for PAVING AND MUNICIPAL ENGINEERING.]

STREET CAR RAILS ON BRICK PAVED STREETS.

What size and form of rail is the best for an electric street railway in connection with a brick paved street, having due regard to cheapness and also the best size rail for smaller purposes on a common country road? *J. H. J., Sarnia, Ont.*

Special conditions require special solutions of this and similar questions. The weight of the car and the number of its wheels, the weight and number of vehicles on the street should be known to determine the size of the rail. The number of cars which are to be run and many other details are necessary to properly answer this question in full. A few suggestions, however, would answer it in part. The best form of rail, all things considered, is generally the grooved rail, such as is used in all cities of Europe and on almost all the street car lines of Washington and on Broadway, New York. This is a rail of the web or I-beam class, about six inches high, the bottom part about four inches across, and the top about 3¼ inches wide, with a groove in the top part about ⅞-inch wide and

⅞-inch deep. Such a rail offers no obstruction to the wheels of vehicles passing over it in any direction, nor is it possible for vehicles to get on the track and remain there and cause delay to the electric car. Street cleaning is much facilitated. The pavement between the tracks is not below the level of the tracks as with other forms of rail. The groove does not become clogged, as persons not familiar with this rail assume. The slight additional resistance to the electric cars by the groove over the T rail is far outbalanced by the fact that the cars seldom, if ever, must stop and lose headway for wagons to get off of the track. This rail is especially desirable for a brick-paved street, because paving bricks are so quickly injured when adjacent to the T or even the L or side-bearing rail.

Whereas the foregoing applies to streets of cities and towns, it is rarely best to use a grooved rail upon suburban roads which have telford or macadam upon them. Even upon gravel roads the L or side-bearing rail is best, especially where such streets or roads are used by many vehicles. This rail for electric cars should be of the web or I-beam class. If the cars are not too heavy, a total depth of five inches is sufficient. The rail should not be supported on iron chairs alone, but with some form of concrete underpinning. The question of foundation, however, is a local one in each case.

For country roads at great distances from cities where there is little travel of wagons a T rail may be used, especially where a portion of the country road can be sacrificed for the sole use of the electric cars. The foregoing general answer hardly indicates the lines upon which special investigations should be made.

PATENT SIDEWALK PAVEMENTS.

Has a pavement called "Flintite," patented by A. P. McKean, eleven months ago, been used in any city for paving streets on a large scale? If not, has it been used in any place known to you for constructing sidewalks?

J. E. Manning, New Orleans.

No street pavement bearing this name has been reported to us. There are several patents for sidewalks as well as mixtures used for that purpose, which have names including the words "flint," granite, slag, and other words indicating the grit or material which is mixed with the Portland cement when the wearing surface of the sidewalk is prepared. There is no reason why any person with experience should not purchase good American or foreign Portland cement and mix with it fine crushed stone or clean, sharp sand with a little water and lay a durable, artificial stone sidewalk. These Portland cement sidewalks, when laid upon a good concrete foundation, are suitable for the heaviest foot traffic of our cities. There are several patented combinations of iron gratings, steel rods, etc., which add strength to the individual blocks into which these sidewalks are often divided, but by using good foundations and proper mixtures, and by keeping the walk wet until the cement is set, excellent results can be obtained.

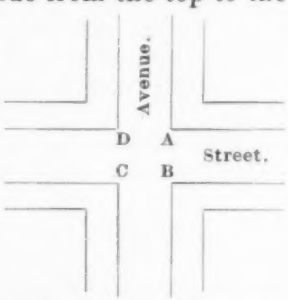
HOW TO DETERMINE THE ELEVATIONS OF STREET CORNERS.

How should the elevation of a street corner be determined, when the adjacent streets slope in opposite or different directions? *H. Ward, Binghamton, N. Y.*

This question is one with as many answers as there are conditions. And the conditions found at different intersections of different streets are almost infinite. It is best to assume that a new town is to be laid out or at least new streets, and not old ones adjusted, because

each adjustment of existing streets with their grades, curb lines, sidewalks, drainage, etc., must be solved by itself by the use of a little engineering and much common sense.

In arranging the intersection of new streets remember to keep the grades as light as possible and the curb intersections at about the average surface of the ground. The accompanying cut is the intersection of an avenue and street where the street slopes from right to left and the avenue from the top to the bottom of the illustration. The street has the greater inclination. The avenue and street at central point of intersection have the same grades. A, B, C, D are curb intersections. A the up-hill corner.



If grade of street or avenue exceeds 3 per cent. it should be flattened at the crossing to that amount.

If the locality will permit, it may even be advisable to make the crossing level in one or both directions. This will affect the detail, but not the principle of the following method:

Select the natural grade elevation of the avenue at the point midway between D and A, or of the street at the point midway between B and A, according as it may be more desirable to keep avenue or street unaltered in grade, and with a 3 per cent. grade, calculate the elevation of A. The elevations of D and B are fixed on 3 per cent. grades from A; C on a 3 per cent. grade from B and from D. Thus the elevations of all four curb intersections lie in the same inclined plane. The special conditions of each crossing must determine whether to start from the center point of line DA, or of BA in fixing the elevations of curb intersections. Whichever one is taken, the grade of the other street has to be slightly altered to meet the crossing, unless it happens to have a 3 per cent. grade. The decision of the engineer should be influenced by the relative steepness and width of the two streets, the relative importance of the two lines of travel, the effect of curb elevations upon adjoining property, and other local conditions.

At points 50 to 100 feet back from the crossing in all four directions the regular or natural grades of the curb lines should be broken so as to meet at points A, B, C and D. Also, at the same points the pavement surface should begin to twist or warp from the regular level section, so as to conform to these broken curb lines.

The elevation of the lot corners can be found by taking the average of the elevations of the points in the two curb lines opposite the corner and adding to it a proper amount to give the desired side slant to the sidewalk.

As for the sidewalks, their crossing should not offer over 8 or 10 per cent. slope across the line of passage; therefore, if the natural grade of either street or avenue exceeds this amount it should be flattened to it, for the width of the sidewalk, and then still further flattened to the 3 per cent. for the pavement crossing.

This introduces some complication in determining the elevations of the intersections, but the method is the same as described above.

A little thought on the above plan will solve almost every intersection of streets, old as well as new.

DEFECTIVE SIDEWALKS IN NEW YORK.

How can defective sidewalks in New York, or the lack of sidewalks be remedied, either in front of houses or empty lots, where the owners neglect this matter to the injury of the public comfort and convenience?

C. V. L.

Requests or complaints should be addressed to "Consulting Engineer Bureau of Water Purveyor, New York City." He, among other thing, has charge of the city sidewalks. An inspection will be made, and a notice served on the negligent owner of the abutting property to make repairs. If repairs or a sidewalk are not made, a resolution is introduced and passed by the common council under chapter 569 of the laws of 1887. Then the department of public works, bureau of water purveyor, at once causes the necessary repairs or new sidewalk to be made, which is charged by special tax against the abutting property. Brief definite complaints always receive prompt attention. The exact location and nature of defect should be stated. Many persons, in other cities than New York, talk and complain, when a simple definite statement on paper sent to the proper authority, couched in polite terms, would show sincerity and produce good results.

COST OF OPERATING ROAD ROLLERS.

Should a town, through its engineer or other proper official, obtain the use of a horse roller when the place has about 6,000 inhabitants and when it is desired to lay macadam roads with a good foundation of large stone or merely six inches of broken stone, the wearing surface being either fine crushed stone or gravel?

J. A. G. Ardagh, Barrie, Ont.

It is difficult to imagine why such a town does not own a steam roller; it is needed for maintenance of macadam and gravel roads, as well as first construction. Good and durable macadam requires a roller to weigh, for its proper construction, as nearly as possible to 4,000 pounds per foot of width of the roller. A light roller necessitates many passes, waste time with inferior results. A steam roller can be obtained of any weight desired and is easier handled than a horse roller. Horse rollers weigh from three to eight tons, the heaviest not exceeding 3,000 pounds per foot of width. They require from four to six horses to draw them. Teams are awkward to handle. Their hoofs damage the partly rolled surface, especially where they are turned about. The maintenance and housing of a steam roller costs little. When not in use it should be under cover and its metal parts greased. A steam roller does not consume food throughout the year as horses do. It is fed with fuel only when used. The rent of the horses, if hired, is more than the cost of the fuel.

The objection to the first cost of a steam roller is answered as follows:

Cost of steam roller, say		$3,500
" horse " "		400
Interest at 5 per cent on cost of steam roller	$175	
Depreciation at 10 per cent. of steam roller	350	
		$525
Interest at 5 per cent. on cost of horse roller	$20	
Depreciation at 10 per cent. of horse roller	40	$60
Bal. *against* steam roller		$465 yearly.
Running expense of steam roller	$5 to $6	per day
Cost of four to six horse team and men	$6 to $10	per day

It is known that a steam roller does more than twice the work in the same time as a horse roller; therefore, the following calculation shows that for forty days' work in a year the steam roller is the cheaper.

$10 (rate per day) x 40 (days) x 2 (see note)	$800
$6 (rate per day) x 40 (days) x 2	240
Balance *in favor* of steam roller	$560

NOTE.—Multiply by two because the steam roller does twice the work in the same time done by the horse roller.

Comparing the balance in favor of the steam roller, $560, with balance against steam roller, $465, it is evident that if the steam roller is used only forty days in a whole year, it is far cheaper than a horse roller, the saving being $95. Most towns would use a steam roller at least one hundred days in a year, in which case, by a similar calculation, the saving would be $935 over a horse roller used for one hundred days. Thus it is seen that with even greater allowances than 10 per cent. for depreciation of wear and repair to a steam roller, it is cheaper for a town to purchase and use a steam roller than to undertake good, economical work with a horse roller.

THE LAYING OF BITUMINOUS ROCK PAVEMENTS.

Does it make a difference in the quality of a bituminous rock pavement if the material when laid is lumpy and the concrete foundation wet?

M. K. Miller, Oakland, Cal.

What is known in California as bituminous rock pavement is one made from natural asphaltic sandstone, heated or "cooked," as it is called there, until it disintegrates or becomes soft. It should be laid when in a soft, homogeneous state. No lumps should be in it. It is desirable to have all the conditions as uniform as possible in order to obtain uniform results. Asphalt pavements, whether made from the mixture of California, Trinidad, Bermudez or other asphalt by artificial means, with sand, or from asphaltic limestone, called "rock asphalt," or from bituminous rock (asphaltic sandstone), they should all be laid without lumps in the mixture as a matter of course, and upon foundations practically dry, the drier the better. It is not wise for the hot material to be placed upon a moist foundation, thus generating steam or vapor, which penetrates the hot asphaltic substance and thus predestines the material to lose some of the bond or cementing quality of the asphalt or bitumen in it. Frost does not freeze pitch, but will attack any water which may have gotten into the mixture.

It is very difficult to solidify a bituminous rock pavement, and every precaution should be taken in laying it. The hard, dense, firm asphalt pavements of Europe and eastern cities of the United States would be a pleasant surprise to such persons of the Pacific coast who have not seen this result with materials often used in their cities. It would encourage them to use every means to obtain a like result from their asphaltic substances, of which they seem to have abundance within easy reach.

BRICK AND MACADAM PAVEMENTS.

Why are bricks being taken up in some cities and the streets macadamized as in Freeport, Ill.? I am informed that a limestone road from Nashville to Washington, long in use, was in 1864 smooth and solid, and in the opinion of my informant, a limestone macadam is the best pavement to be had, notwithstanding the claims of brick. *Jos. Brennermann, La Salle, Ill.*

This question illustrates the fact that the *maintenance* of street pavements is generally forgotten and the minds of most people are constantly seeking a pavement which will endure without repairs. Such a pavement does not exist. Repair against wear must be provided for, it must be paid for. When brick pavements are used, the best are the cheapest, because it is almost impossible to keep a poor brick pavement in continuous good repair. A poor brick pavement must, within a few years, be

replaced by another pavement, either of brick or some other substance.

The first cost of macadam or telford is less than any other form of road surface, but it must be constantly repaired or maintained so that, for streets subjected to medium or heavy traffic, macadam becomes the most expensive surface possible. Brick pavement, when properly laid with the best known brick, will sustain a medium traffic for some years. Experience has not yet taught us how much the maintenance of a brick pavement will cost under varying amounts of traffic, for long periods of years. Many tabulated statements concerning granite, asphalt, wood and macadam exist, the result of many years' experience with these materials upon roadways. Our smaller cities lack systematic tabulated experience of previous street officials. They can not be hoped for as long as the position of a city engineer and the persons charged with the details of street construction and maintenance hold office for but brief periods.

Your reference to a limestone road is best answered by saying that, in the country where the road you refer to is situated, there is but little travel; it is not wise to use limestone for macadamizing city streets. Better results are obtained by using a harder stone, such as trap-rock.

PAINT FOR A CREMATORY SMOKE STACK.

I desire to ascertain the best material for painting a steel stack of a crematory, exposed to salt air and very great heat.

T. S. Oxholm, New Brighton, N. Y.

Salt air and crematory heat are conditions difficult to meet. Most smoke stack paints would fail. The salt air alone will not destroy some paints, but excessive heat will. Asphalt paints, if of genuine natural asphaltum without coal tar, benzine, etc., are generally durable against ordinary heat and salt air. There is an asphalt gum paint from a material found in Texas which is worth trying. There is a Japan known as elastic iron enamel, which has given excellent results on many iron smoke stacks. The marine service records show severe tests with fair success of a smoke stack (Eureka) paint. A steam pipe paint at about fifty cents more per gallon, made by the same company is worth investigating. Asphalt is probably not their base, as their colors are only red and drab. A No. 36 Detroit graphite paint exists, excellent for very high temperatures, although what the effect of salt air and strong wind would be, can not be predicted, but the chemically inert pigment of a graphite paint promises much.

The stack could possibly have been treated in sections before erecting by baking a Japan into its surface, or by the remarkable Bower-Barff iron process.

Under high tempertures the carrier of a paint simply spread upon a surface with a brush is necessarily destructible. The carrier is usually an oil or some substitute. The pigment of a paint does not combine chemically with a metal stack, it is simply mechanically held there by the carrier. The carrier substance being destroyed, the pigment scales or powders off.

PAVING AND MUNICIPAL ENGINEERING can not more than make the above suggestions from courtesy to a subscriber, because the subject of paint is not directly connected with the field which this magazine attempts to cover.

CURRENT INFORMATION.

LEGALITY OF TAXATION FOR STREET SPRINKLING.

A decision was rendered recently in Kansas City, Mo., by Judge John F. Philips, which, while not final for the reason that it will be carried to a higher court, is of much importance, and more especially in Springfield, Mo. Judge Philips held that under the laws of Missouri taxes can not be levied to pay for street sprinkling. In regard to the decision Judge Philips said: "The law does not permit a municipality to assess taxes against property owners for improvements other than those of a permanent nature which enhances the value of their property. Street grading, sewers, pavements and sidewalks are of this latter class—they are permanent and add to the value of the adjacent property. Sprinkling and cleaning streets are not permanent. You add nothing to the value of a man's real estate by sweeping the street in front of it. The street is just as dusty to-morrow. It is not a lasting benefit; you might as well plant flowers and mow the lawn for him, it is the same thing. The supreme court of the state of Illinois in a similar case held the same opinion, and numerous other authorities sustain my decision."

City Counselor H. C. McDougal, of Kansas City, says: "The supreme court of Minnesota held just the opposite to be true in a similar case. It said that it was impossible to draw an arbitrary line between improvements of a permanent nature and those that were merely transient. A stone wall, a house, a pavement won't last forever, and as a consequence were but temporary in the strictest sense, although generally held to be more enduring. Anything which enhanced the value of a man's property this court considered subject to taxation, and sprinkling and cleaning a street in front of a man's residence or place of business, it held, made it more desirable. Hence such improvements could be ordered and tax bills could be issued therefor."

In Springfield, where some of the streets are sprinkled by voluntary subscription, and many are sprinkled by levying special tax bills, the decision means that no streets which are sprinkled under the tax bill system will be sprinkled next year, unless the voluntary subscription plan is resorted to, as no contractor would care to take the risk with such a decision staring him in the face.

OPINIONS AND RECOMMENDATIONS OF A FAMOUS MAYOR.

The annual message (the seventh) of Mayor Pingree of Detroit is a remarkable document when compared with the conventional official paper. It is aggressive, positive, direct, original throughout. He reviews the famous street railway franchise fight, which resulted in cheaper fares, and says to the council:

> The people of the whole country have been attracted by our labors in street car matters. They are looking to Detroit for good examples. A settlement which would lead to a consolidation of the three roads, in my opinion, would be a public calamity unless coupled with the principle of municipal control. The moment the spirit of competition is destroyed, the public service will be weakened.

As a result of the fight, there is

now pending a proposal by the Detroit railway to operate all the street railway lines of the city at a rate of two and one-half cents per passenger, the company to pay the interest upon the purchase price of the street car tracks, when all the tracks of the city are condemned by authority of the legislature, the purchase price to be decided by arbitrators. The same proposition embodies the offer of general transfers, which, in this case, would mean universal transfers.

The mayor attacks the charges for telephone service in Detroit. He plainly says: "The telephone company is simply robbing the people to pay large dividends on stock which represents an actual expenditure of not more than a quarter of its face value." He advises the council to decide what shall be a reasonable charge for telephone service, and then compel the company to adopt such rates. On the subject of bribery he says:

> Several times since I have been mayor of this city, public officials have been caught with bribe money in their hands, supplied them by persons high up in business and social circles. * * * Persons seeking franchises are constantly trying, often by means of ill-gotten money, to buy priceless privileges and establish vested rights in the very heart of the city. As a result, many an honest man, who is poor, falls before the tempter. As long as society is practically indifferent to bribery, so long will pure municipal government be well-nigh impossible.

He mentions the construction during 1895 of 21.97 miles of sewers, public and lateral, at a cost of $217,732.37, giving the city a total of 425.86 miles of sewers, which have cost $5,426,158.72.

The street paving during 1895 embraced 11.5410 cedar blocks on concrete, 0.9181 asphalt on concrete, and 1.1828 brick on concrete, and by way of comment, the mayor says:

> The condition of our streets has proved beyond a doubt that the days of the cedar block are past. Nothing has yet been discovered as good as asphalt properly laid on concrete foundation.
>
> If the aldermen will make a careful study of paving, they will have no hesitation about supporting me in this matter. In Montreal, the board of health, which, fortunately, is a municipal board, not one of the adjuncts of the state, has demonstrated that sixty-eight per cent. of all the cases of diphtheria occurred on streets paved with wooden blocks.
>
> A few old fogies still stand for cedar blocks, just as a few cities still tolerate horse cars; but to be up to the times, we should get rid of the blocks as fast as possible and replace them with asphalt on solid concrete foundation.

He says the water supply system of the city has grown to be old-fogyish, "without any merit in it to warrant its continuance." He advocates the abolition of the water rates and the substitution of a general tax to cover the expense of water supply. In this way, he argues, improved real estate held for speculative purposes would be compelled to pay its proportion of this kind of public service, and, anyhow, he thinks the general taxation plan is the most equitable.

He suggests, but does not advocate, direct legislation as the best protection of public rights. He favors a system of savings by school children similar to the one inaugurated at Brocton, Mass., a few years ago. He indorses the eight-hour rule in municipal work, and he also urges another appropriation of $5,000 for further trial of his plan of potato raising by poor people on unused land. He urges a change of the tax assessment system so as to make the tax on mercantile and manufactured products of labor merely nominal, thus stimulating, as he believes, the industry and commerce of his city, which will result in general benefit locally.

PAYMENT FOR PAVING BY A STREET RAILWAY.

In a suit for $2,185, brought by the city of Shamokin, Pa., against

the Shamokin Street Railway Company, for the company's share of the expense connected with the paving of a portion of Shamokin street with asphalt, Judge Parker decided February 12, that the company was under no obligation to pay the money, as it had not expressly agreed to do so when the ordinance giving it the right of way was paved. An appeal will be made to the supreme court, as this was a test suit.

COL. WARING ON GARBAGE DISPOSAL.

A report on the disposal of garbage, street sweepings, horse manure, etc., is in course of preparation by Col. Geo. E. Waring, Jr., street cleaning commissioner of New York, and will be published in the near future. The dumping of refuse matter at sea, Col. Waring refers to as "wasteful and pernicious." In a general way he says: "It is known that garbage can not be economically utilized if it is mixed with any considerable quantity of rubbish or ashes; it is known that it can not be economically incinerated unless it is separated at least from the bulk of the ashes with which, under the prevailing New York practice, it is mixed; it is known that ashes can not be used as a filling material so long as they contain such waste organic matters as constitute the garbage and some of the rubbish of city collections; it is also known that a very considerable part of garbage and rubbish, as collected throughout the city, is of sufficient value to pay more than the cost of its collection."

When bids were wanted a year ago for disposal of the garbage of New York, only one of the twenty-six companies which submitted proposals was willing to undertake the work without pay from the city. The average of the prices named was 55 cents per ton for utilization, and 90 cents for cremation processes. Most of the bidders were regarded as either irresponsible or without adequate experience.

On the subject of the extraction of grease from garbage the commissioner says that the hydro-carbon processes are more thorough than any other; that the acid processes, as a rule, do not give good results; that mechanical processes extract a fair percentage of the grease. As to tankage, or available fertilizing material, and regarding utilization systems in general, the average composition of garbage and its selling value after being subjected to reduction, the report says: "The tankage is of varying quality, according to the method used and the class of garbage handled. All reduction methods, properly conducted, can be made unobjectionable from the sanitary point of view. The faults seem to come from the want of experience in construction, for what has been found offensive in one plant has been so handled in another as to be entirely without offense."

Three thousand tons of garbage, from different cities, treated by different methods, show a general average composition of:

	Per cent.	*Lbs. per ton.*
Rubbish	7	140
Water	71	1,420
Grease	2	40
Tankage	20	400
	100	2,000

The selling value of a ton of garbage when treated is:

Grease, 40 lbs., at 3 cents	$1.20
Tankage, ammonia, 13 lbs., at 8 cts.	1.04
Phosphoric acid, 13 lbs., at 1 cent.	.13
Potash, 3 lbs., at 3½ cents	.10
Total	$2.47

The quantity of garbage collected in pounds per day per capita in

eight American cities is given as follows:

Buffalo	0.245
Boston	0.946
Wilmington	0.805
St. Louis	0.277
New Bedford	0 890
Cincinnati	0.566
Philadelphia	0.332
Lowell	0.408

The conclusion is reached in the report that grease can be easily sold, and that it will be best to offer tankage for sale as such to manufacturers of fertilizer, rather than attempt to make it a finished product ready for market.

USE OF STREET CARS IN COLLECTING GARBAGE.

Jacob Guthard, president of the board of public works, Detroit, Mich., suggests that in granting future franchises to either of the street railway companies, the city should reserve the right to run garbage cars over the tracks of the different companies at night, the companies to furnish the power without charge. He says: "With a system of garbage cars the cost of cleaning the streets and alleys would be materially reduced. The whole work of carting away the garbage could be done with ten cars, and one or two motors would be all that would be necessary to haul the cars. What I would do would be to have three or four stations about the city where the cleanings could be taken in the wagons and dumped on a raised platform. There are plenty of vacant lots where these platforms could be erected, and there is nothing offensive about the ashes or street sweepings. Then there could be switches placed from the tracks of the companies into these lots."

SEWAGE DISPOSAL AT CLEVELAND.

The plans agreed upon by the consulting engineers employed by Cleveland for disposal of the sewage of that city provide for its discharge ten miles from the water supply intake. This can be effected at less cost than a purification system, for which the estimated per capita per year would be thirty cents, aside from capital charges. The proposed discharge of the sewage at a distance of ten miles from the intake will necessitate high and low level intercepting sewers, and pumping for some districts will be required. It is recommended that provision be made for 20 cubic feet (150 gallons) of sewage per inhabitant per day for a population of 1,000,000, with a maximum flow of 26 to 28 feet; also that the first surface wash from rainstorms and all the yield of slight rains should be carried by the interceptors, raising their capacity per inhabitant to 54 cubic feet, or about 400 gallons per day, or a total of 400,000,000 gallons. A fall of two feet per mile was assumed as the proper grade for the sewer and a diameter of 13 feet, both at the lower end, the fall increasing and the diameter decreasing towards the city end. This is designed to give a velocity of four feet per section. A main pumping station, with auxiliary lifts by means of shore ejectors or electric pumps is proposed for the low level sewage. The system is designed to exclude all house sewage and manufacturing wastes from the Cuyahoga river, which is now badly polluted. The separate system of sewerage is recommended for the portion of the city where pumping will be necessary. The report is made by G. H. Benzenberg, Desmond FitzGerald and Rudolph Hering, and, in the main, is concurred in by M. E. Rawson, city engineer, and M. W. Kingsley, superintendent of water-works.

A NEW PLAN FOR ROAD IMPROVEMENT.

To improve the roads of Pennsylvania, Arthur Kirk suggested, in a recent lecture in Sharpsburg, Pa., that the state construct military highways across the state every forty miles apart, and cross these with similar roads forty miles apart. No part is to be more than a 3 per cent. grade. The roads are not to interfere with the present roads. As soon as a military highway is finished grading from one place to another, say fifteen to twenty miles apart, the secretary of internal affairs is to sell at public auction to the highest bidder above cost, a lease to use that road for twenty years with a double line street railroad carrying both freight and passengers, and, at the end of that time re-sell at public auction the right to use it as above every twenty years.

The state could issue bonds, say $12,000,000 worth per year, to pay for building the roads, and the bonds could be paid by the rental. After these cars have been running five years the land on each side of the track and back two miles on each side of the road is to be appraised to ascertain how much it has increased in value by the making of that road; and the found increased value is to be paid into the road fund so as to meet the payment of its construction bonds as they fall due after twenty years.

COST AND PROFITS OF GARBAGE DISPOSAL.

In the interest of the street cleaning department of New York city, Mr. Hawthorne Hill, consulting engineer to Geo. E. Waring, street commissioner, has been inspecting the garbage reducing plants in St. Louis, Philadelphia, Buffalo, Baltimore, and other cities. Some time was spent in Bridgeport, Conn., examining the Utilization company's plant. In a talk on garbage collection and disposal, before the board of health ofthat city, February 11, Mr. Hill said that the question that concerned the street department in New York city most was the disposal of garbage in a sanitary manner. The matter of collecting was not considered to be of consequence, as the garbage had to be collected anyway, but what to do with it after it was collected was worthy of careful consideration. In response to a question as to whether he deemed the Holthaus system (the system employed by the Utilization company) a sanitary method of disposal, Mr. Hill said that it could not be otherwise than sanitary, as the garbage was placed in a hermetically sealed tank and was not again exposed to the air until it had been converted into a solid matter from which there was no offensive odor. When informed that the city was getting its garbage reduced at present for $3.40 per day, he said that it was a very low price to pay and that the city was fortunate in securing the contract at the rate of 34 cents per ton.

One of the most interesting of Mr. Hill's statements was that not one of the various companies reducing garbage for the residuum had as yet brought its system to such a state of perfection that the revenue derived from the sale of grease and fertilizers equaled the cost of their production. In other words, garbage reduction is as yet an unprofitable business. He said the average rendering of grease and fertilizers resulted in about 60 pounds of grease at three cents per pound, and 400 pounds of fertilizer solid at 23 cents per hundred weight, or a total production worth $2.70 per ton of garbage

handled. "Capitalists who have ventured to put their money into garbage reducing plants have had to run the chance of an increase in the amount of garbage handled sufficient to tax the resources of their plants. In this way alone can they make the business profitable, for they then can get all there is in the machinery out of it," said Mr. Hill. "To explain, the local plant, for instance, has a capacity of about 90 tons per day. It is necessary to use a stated amount of coal whether the amount of garbage reduced be 10 tons or 50. A certain amount of labor is now employed. It is not hard to see that the force of laborers would not have to be increased in proportion if the garbage handled were double in volume. Then much depends on the growth of the city in which the plant is located. A plant started at a loss may become profitable in a very few years by reason of the increase of business on account of the increase in population. Indeed, I think that this proposition might be safely applied to the outlook for the future of the company which operates your local plant."

Mr. Hill said, Baltimore produced more garbage than any city of its size in the country, on account of the predominance of wealthy people in its population.

COST OF CRUSHING STONE FOR HIGHWAY IMPROVEMENT.

At the last meeting of the Farmers' Club, held at Onondaga, Geo. P. Clark, road commissioner of Onondaga, read a paper on "Road Improvement," in which he told what he had accomplished with an appropriation of $1,500. The larger part of the sum was expended in crushing stone and distributing the crushed stone on the roads. He moved his stone crusher from place to place, breaking from 200 to 450 cubic yards at each place, and altogether he crushed about 3,000 yards. The stone was taken from the crusher and put on the roads by a one-horse team, in a large distributing wagon, built for the purpose. Mr. Clark's description of his own methods, together with his recommendations to others, were set forth as follows:

Locate the crusher as near to the road to be improved as possible and yet be convenient to the stone to be crushed. When near, use a two-horse team with three wagons, one being loaded, one being unloaded, and one going to and from the stone pile to the crusher, hauling from one-third to one-half cord at a load; this being sufficient to keep the crusher running and producing six to eight yards per hour. It usually requires two men with one or two additional men to break the large stone, making six or seven men and one team, and about one-third of the time two teams. My distributing wagon holds three yards. The rear axle is one foot wider than the fore axle, and the tires are six and eight inches wide. Crushed stone was put on in depths varying from two or three inches to a foot, depending on the foundation grade and kind of travel over the road. As far as practical, the coarser stone has been put at the bottom, and the finer on top, and to some extent rolled down by drawing my loaded wagon over the roads, when wet by recent rains.

I am often asked how much it costs per cord to crush stone; and how much it costs to put the stone on the road. So far I have had stone rolls or stone in quarries free. The cost of loading, hauling, and feeding the crusher has been about as follows when I have hired it all done: A team and a half at $3 per day, $4.50 per day; from six to seven men at $1.25 per day would cost $8.50; the engine, coal, oil and repairs, about $4.75, so that crushing 65 yards would cost about $17.75 per day, or about 27½ cents per yard. To this should be added an average of $1.75 per day cost of moving from place to place, and resetting the crusher, bringing the cost up to about 30 cents per yard. I have charged $5.50 per day for taking and distributing from the crusher, or about 8½ cents per yard. This is exclusive of the cost of wear and interest on the crusher, and supervision of the commissioner. When this has been added, allowing the cost and wear at $4 and commissioner's salary $2, would cost a little less than 50 cents per yard for crushing and spreading on the road at distances within one-half mile

from the crusher. For greater distances there would be added about 10 cents per yard for each half mile.

NEW ASPHALT PAVING SPECIFICATIONS.

The new specifications for asphalt paving adopted by the city of Indianapolis read as follows:

1. Upon the concrete foundation prepared as specified, shall be laid a wearing surface or pavement proper, the basis of which or paving cement will be pure asphaltum unmixed with any of the products of coal-tar.

2. The asphaltum to be used in this improvement shall be the best quality of standard Trinidad asphalt, commonly known as Pitch Lake asphalt, mined directly from Pitch Lake in the Island of Trinidad, or Bermudez asphalt, or asphalt of a quality equal in all respects or superior thereto. It shall be specially refined and brought to a uniform standard of quality in purity and gravity to be approved by the city engineer and the board of public works.

3. Heavy petroleum oil used in the paving cement shall be a petroleum from which the lighter oils have been removed by distillation, preferably especially for paving purposes, until its specific gravity is 18 to 22 degrees Beaume and its flash point not less than 300 degrees in a New York State closed oil tester.

4. Sand shall be fine sharp river or lake sand, perfectly clean. Fifteen per cent. of it may pass through a sieve of 80 meshes to the lineal inch and all of it shall pass through one of 20 meshes.

5. Pulverized carbonate of lime shall all pass through a screen of 26 meshes to the lineal inch, and 85 per cent. shall pass through a screen of 100 meshes to the lineal inch.

6. Asphaltic cement shall be prepared from refined asphalt and heavy petroleum oil, and be of composition and consistency satisfactory to the engineer. The proportions shall vary according to the respective viscosity of asphalt and oil between the limits of 10 and 21 pounds of oil per 100 pounds of refined asphalt.

7. The wearing surface of the pavement shall be composed of the above materials mixed with the following proportions by weight:

Asphaltic cement 9 to 16 per cent.
Sand 74 to 88 per cent.
Limestone dust 3 to 10 per cent.

The exact proportions of materials used within these limits will depend upon their character and the location, grade and traffic of the street, and the formula to be used shall be such as is approved by the engineer. It is expressly understood that the contractor is, under any circumstances, responsible for the condition of the pavement during construction and the guarantee period, but if he shall fail or refuse to submit the formula for pavement to the engineer for approval, the engineer shall have the right to prescribe the formula to be used.

8. The sand and asphaltic cement are to be heated separately to about 300 degrees Fahrenheit. The pulverized carbonate of lime while cold will be mixed with the hot sand in the required proportions, and will then be mixed with the asphaltic cement at the required temperature and in the proper proportions, in an apparatus suited to effect a perfect mixture.

9. The engineer and his authorized representatives shall have access to the works at any time that work is under way therein for the purpose of inspecting materials, temperatures, methods and results, and shall be given all facilities and assistance necessary therefor. He shall be furnished with all samples of materials and mixtures that he may require. He shall have the authority to modify methods of treatment, proportions of mixtures and temperatures at any time within the limits prescribed.

10. The pavement mixture thus prepared will be laid on the concrete foundation in two coats. The first, called the cushion coat, will contain more asphaltic cement than the surface coat. It will be laid to such a depth as will give a thickness of ½-inch after being consolidated by a roller. The second, called the surface coat, prepared according to the approved formula, will be laid on the cushion coat. It will be brought to the ground in carts at a temperature not less than 250° nor more than 325° Fahrenheit. If the temperature of the air is less than 50° Fahrenheit, the contractor must provide canvas covers for use in transit. It will then be carefully spread by means of hot iron rakes in such manner as to give a uniform and regular grade, and to such depth that after having received its ultimate compression it will have a thickness of two inches. Temperatures will vary with the weather as directed by the engineer. The surface will then be compressed by a hand-roller, after which a small amount of hydraulic cement will be swept over it. It will then be thoroughly compressed by a steam roller weighing not less than 200 pounds per lineal inch of roller, the rolling being continued as long as it makes an impression on the surface, at least five hours for every 1,000 yards of surface. The asphalt surface may be laid in one coat of 2½ inches thickness when consolidated. In order to make the gutters, which are consolidated but little by the traffic, entirely impervious to water, a width of 12 inches next the curb will be coated with hot pure asphalt and smoothed with hot smoothing irons. Great care must be taken not to disfigure the curb, sidewalks or lawns with the material and any damage on this account must be prepared by the contractor.

11. Whenever required by the engineer

the grade of the surface shall be tested with water and shall be of such perfect surface that no pools of water shall stand on the pavement or in the gutters. Any depressions which show at any time during the guarantee period shall be relaid to grade.

12. It is expressly understood that the work done shall be equal to the best asphalt pavement laid, and that the guarantee shall not relieve the contractor from furnishing a pavement which, when completed, will not become so pliant during hot weather as to make it unsuitable for practical use, nor so unyielding as to crack and cause disintegration in cold weather, but which will have a good, smooth surface suitable at all times for the various demands of ordinary travel.

13. The kind of asphalt to be used shall be stated in the bid and shown by the samples filed.

14. The city engineer shall be notified when a shipment of refined asphalt is received, and no asphaltum shall be used in making asphaltic cement, until inspected and approved by the city engineer. The contractor shall give the city engineer at least forty-eight (48) hours' notice, in writing, before any part of the wearing surface is mixed, and it is expressly understood that any part of the pavement laid without such notice having been given, shall be taken up and relaid if the city engineer so directs.

15. Bidders, who have not an asphalt plant in this city, must present satisfactory evidence to the board of public works and the city engineer, that they have been regularly engaged in the business of laying asphalt pavement, and that they are fully prepared with the necessary capital, material and machinery to conduct the work to be contracted for, and that they shall construct the necessary plant and be ready to operate and lay pavement within sixty days after the letting of the contract; that they have constructed an asphalt pavement, with the kind of asphalt stated in the bid, in other cities, which, after having been subject to heavy traffic for three years and to variations of temperature from twenty (20) degrees below zero Fahrenheit to one hundred ten (110) degrees Fahrenheit, shall be equal to the best asphalt pavement in this city.

16. The contractor, upon the completion and acceptance of the work by the board of public works, will deposit with said board city of Indianapolis improvement bonds equal to an amount of twenty (20) cents for each square yard laid, and within the guarantee period of nine years the improvement bond guarantee shall not be decreased to an amount less than will be equal to ten (10) cents for each square yard laid.

NO TARIFF ON IMPORTED CRUDE ASPHALT.

The Trinidad Asphalt Company has obtained a favorable decision to the company upon the appeal which it took to the board of general appraisers, who unanimously reversed the decision of the collector of Galveston, Texas. The collector had levied a duty of 20 per cent. upon some dried asphalt, claiming that all extraneous matter had been eliminated and the substance was therefore refined or manufactured asphalt. As all crude asphalt is free of duty, this decision is of general interest. It is stated that the Secretary of the Treasury will bring the matter before the United States circuit court at Galveston for final determination as to whether the drying of asphalt by any process causes the asphalt to be any other than a crude material.

PERSONALS.

Mr. John Robinson has been reappointed town clerk, at Niagara Falls, Ont.

Mr. J. M. Barclay, city engineer at Steubenville, Ohio, died January 28.

Mr. Henry Lang, ex-mayor of Newark, N. J., died of heart disease, February 18.

Mr. E. J. Croly has been appointed superintendent of streets, at Sacramento, Cal.

Mr. Timothy L. Woodruff has been appointed park commissioner at Brooklyn, N. Y.

Mr. Frederick B. Gleason has been elected superintendent of streets, at Marlboro, Mass.

Mr. B. W. Wells succeeds Mr. Wheeler as superintendent of streets, at Boston, Mass.

Mr. W. D. Keating has been appointed assistant engineer of the Chicago Drainage Canal.

Mr. O. J. Morris has been elected superintendent of water-works and sewers, at Hillsboro, Tex.

Mr. M. Jenson has been appointed superintendent of water works, at Salt Lake City, Utah.

Mr. Robert W. Fielding has been appointed deputy commissioner of city works, Brooklyn, N. Y.

Mr. Charles F. Karstens has been selected alderman to represent the First ward, at Fon du Lac, Wis.

Mr. Thomas I. Cavanaugh has been appointed a member of the sewer commission at Taunton, Mass.

Mr. Edward C. Ellis has been appointed assistant water commissioner of Boston, Mass., by Mayor Quincy.

Mr. William W. Locke has been reappointed sanitary engineer of the department of health, Brooklyn, N. Y.

Mr. Walter G. Kirkpatrick, Assoc. M. Am. Soc. C. E., Nashville, Tenn., has accepted an appointment in Mississippi.

Mr. Ernest W. Bailey has been appointed city engineer, and Mr. George A. Kimball consulting engineer, at Somerville, Mass.

Mr. C. F. Knowlton, Boston, has been appointed commissioner of public works, at Quincy, Mass., to succeed Mr. W. N. Eaton.

Mr. C. W. Smith, who resigned his position as water commissioner, at Boston, Mass., has been succeeded by Mr. J. R. Murphy.

Mr. John T. Desmond, Haverhill, Mass., succeeds Mr. Frank P. Johnson as city engineer and superintendent of streets, at Waltham, Mass.

Mr. Perry G. Babcock has been appointed superintendent of water works, to succeed Mr. Barton Hallenbeck, who resigned, at Chatham, N. Y.

Mr. D. A. Reed has been appointed a member of the board of public works, at Duluth, Minn., to succeed Mr. W. B. Welles, who has resigned.

Mr. George C. Power, M. Am. Soc. C. E., has been reappointed city engineer, at Ventura, Cal. Mr. Power has served eight years in the position.

Prof. Henry Leffmann recently delivered a lecture at the Academy of Natural Sciences, Philadelphia, Pa., on "Ancient and Modern Municipal Water Supply."

Mr. C. A. Allen, of Worcester, Mass., has been nominated to succeed Mr. J. R. Freeman, of Winchester, who resigned his position on the Metropolitan Water Board.

Mr. Emil Kuichling, M. Am. Soc. C. E., addressed the engineering section of the Academy of Science, Rochester, N. Y., on "Electrolysis of Water Pipes," February 3.

Mr. Charles H. Mitchell, for the last year city engineer at Niagara Falls, Ont., has been appointed chief engineer of the proposed new system of sewers in that city.

Mr. Clarence Coleman, United States assistant engineer, at Marquette, Mich., read a paper on "Macadamized Streets and their Construction," at a regular meeting of the common council of that city, recently.

Mr. John H. Pearson has been appointed city engineer at Louisville, Ky., to succeed Mr. Charles V. Mehler. Mr. J. B. F. Breed has been reappointed chief assistant engineer.

Mr. Patrick O'Shea has been appointed deputy superintendent of the sanitary division, Boston, Mass., and Mr. Wm. H. Carbury has been made superintendent of bridges.

Mr. George T. Prince, Atlantic City, N. J., has resigned his position as superintendent of the water department to accept that of chief engineer of the water plant at Omaha, Neb.

Mr. Charles P. Chase, of the Iowa Engineering Co., Clinton, Ia., has been appointed consulting and inspecting engineer of bridges for the Clinton county board of supervisors.

Mr. William M. Dean, New York city, died February 6. He served as superintendent of street improvements in the department of public works of New York city, from 1886 to 1895.

Mr. Alfred P. Bolles, East Orange, N. J., has been appointed by the board of public works, at Newark, N. J., as consulting engineer in the proposed separation of grades of the railways and streets.

Messrs. John W. Alvord and W. S. Shields will, under the firm name of Alvord & Shields, carry on civil, hydraulic, and sanitary engineering, with offices in the Rookery Building, Chicago.

Mr. F. W. Cappelen, city engineer at Minneapolis, Minn., read a paper January 28, before the Engineers' Club of Minneapolis, on the subject of "The Water-works of Minneapolis and St. Paul."

Mr. Russell R. Stewart has been appointed city engineer, at Syracuse, N. Y., to succeed Mr. H. C. Allen, who resigned. Mr. Daniel O'Brien has been appointed commissioner of public works for two years.

Mr. Ackley P. Fuller, who has served for a number of years as a member of the board of water and sewer commissioners, at Rome, N. Y., has resigned, and Mr. John S. Baker has been appointed as his successor.

Plans and specifications for a water and electric light plant have been prepared for Lynchburg, Ohio, by Mr. E. F. Layman, C. E., of Cincinnati. Mr. Layman is also preparing plans for a water and light plant at Loveland, Ohio.

Mr. Gordon H. Taylor, the topographical engineer of Boston, who has had extensive experience in making surveys of both private estates and public parks and reservations, has recently finished the topographical survey of 7,000 acres of land taken by the Metropolitan Park Commissions, in which work he was associated with the firm of French & Bryant.

Mr. A. T. Bell, city engineer, of Memphis, visited several northern cities on official business in February. He reports that much public work will be done in Memphis this year, and that it will be largely brick and granite street paving.

Mr. Edwin Thacher, of the firm of Keepers & Thacher, Detroit, Mich., visited Little Rock, Ark., February 7 and 8, to consult with the free bridge commissioners relative to the free bridge which is to span the Arkansas river at that point.

Mr. Van Brunt Bergen, M. Am. Soc. C. E., who has for thirty-two years filled different positions in the engineers' bureau of the department of city works, Brooklyn, N. Y., has resigned his position as chief engineer of the department. The appointment of a successor is improbable, the present policy being to divide the responsibilities between the three division engineers, Messrs. I. M. de Varona, of the water bureau, C. H. Meyers, of the sewer bureau, and M. T. Lewis, of the street bureau.

MACHINERY AND TRADE.

THE VULCANITE PORTLAND CEMENT WORKS.

The new cement mill of the Vulcanite Portland Cement Company, Vulcanite, N. J., was visited recently by a representative of this magazine, accompanied by Mr. B. F. Stradley.

The company has two banks of stone, the one from which they are now taking their material being located about five hundred feet from the mill buildings. The stone obtained is first-class, and contains all the qualities for the making of the finest cement, except that it is not high enough in lime, and it is necessary, therefore, to bring a limestone some distance. After being brought to the mill, these two materials are carefully weighed (records being kept of exactly the amount of each material used, and tests being made every day of the two raw materials, so that there is hardly a possibility of a poor quality or low grade material being used) and exactly proper proportions are dumped into a Gates Rock crusher. The partially crushed mixture is carried by means of an elevator and conveyor to the raw material grinding mills, the mixture having first passed through a rotary kiln, and being partially dried, from there it is again in turn conveyed to another building and passes through two immense rotary drier kilns, and the mass is heated to a white heat by oil flames under very high pressure. From these kilns the mixture issues in the shape of hard burned clinkers, and is elevated to the cooling chamber, an immense iron tank, through which cold air is kept circulating. From the cooling chamber the mass is passed through pulverizers or crackers and is then conveyed to the finishing mills, and from there the now finely ground cement is taken to an immense stock house, where it is allowed to remain in bulk from one to two months before being put in barrels or bags preparatory to shipment. The plant is one of the best equipped in the country and tests of this cement show it to be of exceptionally high grade.

C. O. R.

TRADE NOTES.

St. Albans, Vt., contemplates the purchase of a stone-crusher.

The purchase of a stone-crusher is contemplated at Paterson, N. J.

The purchase of a stone-crusher is being considered at Middlebury, Vt.

Oswego, N. Y., has in contemplation the purchase of a stone-crusher.

The purchase of a stone-crusher and road roller is contemplated at Esopus, N. Y.

The commissioners of highways, Newburgh, N. Y., contemplate the purchase of a stone crusher.

J. J. Galbraith, city clerk, Williamsport, Pa., says the city may buy a street sweeper in the near future.

The purchase of a rock-crusher is proposed, at Sedalia, Mo., preparatory to the construction of a rock road.

The Kenilworth Brick Works, near Wellsville, O., have been purchased by the Park Fire Clay Co., of Conway, Pa., for $25,125.

Sealed proposals will be received until March 12, by R. L. Hoxie, major of engineers, of Pittsburg, for 600 net tons of Portland cement.

Messrs. Anderson, Montana and Masslick have been appointed a committee, at Union City, Ind., to negotiate for the purchase of a road-roller.

The purchase of a steam road roller and a large scraper for street work has been recommended by Superintendent Howard, at Los Angeles, Cal.

Allen Jackson & Co., manufacturers of paving brick at Akron, O., passed into the hands of a receiver January 30. Liabilities $30,000; assets, $15,000.

At a recent good roads meeting in Los Angeles, Cal., Mr. Mande suggested that each county should have a rock crushing plant with portable machinery.

The mayor and three councilmen were appointed a committee at Cartlege, Mo., recently, to visit several cities where road rollers are in use. If the investigation results satisfactorily one will probably be purchased.

The city council, Kalamazoo, Mich., contemplates the purchase of a stone-crusher, a five-ton road-roller, a reversible road-grader, and a breaking plow.

The Onondaga Vitrified Brick Plant, located at Warrens, N. Y., has been purchased by Hon. W. K. Niver, Henry Lacy and Seward E. Bowman, of Syracuse.

Sealed proposal will be received until March 9, by Frederick Aboot, captain of engineers, Charleston, S. C., for furnishing and delivering 10,000 to 15,000 barrels of American natural cement.

The officers of the Climax Road Machine Co., Marathon, N. Y., for the ensuing year, are: President, A. H. Manning; vice-president, Edward L. Adams; general manager, O. F. Pinckney; secretary and treasurer, T. R. Clark.

The city council of Burlington, Vt., has placed an order for several more street sprinklers with the Studebaker Bros. Mfg. Co., South Bend, Ind. The city purchased four of these sprinklers last year, and it is probable that they will increase the total to fifteen machines.

The Studebaker Bros. Mfg. Co., of South Bend, have issued a new catalogue devoted to their sprinkling wagons. It is elaborately illustrated, and every detail of the advantages of their sprinkling wagons is strikingly set forth in both text and pictures. An impressive feature of the illustrations is a series of half-tone reproductions of photographs showing from a dozen to forty Studebaker sprinkling wagons about to start on their rounds in different cities. These pictures, it is explained, occupy the space in the catalogue usually given to testimonial letters. The catalogue will be mailed to any address by the Studebaker Co. on request.

LETTERS FOR THE PUBLIC.

SAN FRANCISCO'S GARBAGE DISPOSAL CONTRACT.

Mr. Ernest McCullough, consulting engineer of the Merchants' Association of San Francisco, sends a letter of considerable length to Paving and Municipal Engineering, reviewing the sale on Feb. 10th of a franchise for disposal of garbage in San Francisco for a term of fifty years. The advertisement for the sale of the franchise requires the building of a crematory or reduction works, and permits a charge of 20 cents per cubic yard for garbage delivered at the works. It is made a condition of the contract that, after the erection of the reduction works, it will be made unlawful for any one to deposit within the city limits any garbage or refuse. Bids for the franchise were submitted by L. V. Merle, a clothing dealer, who offered $5,500; L. M. Skelly, who offered $1,105, 1 per cent. of the gross proceeds for the first fifteen years, 2 per cent. for the next fifteen years, and 3 per cent. for the remainder of the time; F. A. Sharon, a millionaire, who offered $2,500, 2 per cent. of the gros proceeds for the first fifteen years and 5 per cent. for the remainder of the time. The Merchants' Association protested against the sale of the franchise, because it was against public policy and was for too long a time. Commenting on the matter, Mr. McCullough says:

I have made the following estimate, taking in all cases the minimum figure and amounts: From reports of Boards of Health, one ton of garbage, as collected in wagons, drains down to half a ton when allowed to stand on platforms a few hours. It loses in weight 50 per cent., but the bulk is only slightly reduced. It is thus better to charge by weight instead of bulk when destroying garbage, as the men who haul it must charge by weight, and the men who destroy it will charge by dry bulk if they get an opportunity. The usual custom in other cities is to charge by weight both when hauling and destroying garbage.

After the surplus water has drained from the garbage, an analysis of the residue reveals that from 70 to 80 per cent. is moisture, from 15 to 25 per cent. is solid matter and from 3 to 6 per cent. is grease. This grease is worth from 3 to 4 cents per pound at refineries and the solid matter is made into fertilizer worth from $8 to $10 per ton.

Experience in other cities show that there is little difficulty experienced in disposing of the products of a reduction works, although the owners of such works state that they are losing money every year. Water works and street car companies also are in the habit of making the same complaint.

The quantity of garbage to be removed from a city varies in every city, and also according to the ideas of the Health Officers as to what constitutes garbage. It is probably safe to estimate on a minimum of 300 pounds per capita each year of wet garbage. This will drain to 150 pounds to be destroyed.

Assuming the population of San Francisco at 300,000, there will be reduced annually 45,000 tons of garbage. This must be hauled, and the following estimate will give closely the cost of hauling.

A two-horse wagon should carry easily one ton and make two trips per day to the works and collect the garbage.

Interest, repairs and renewals on outfit	$ 20
Feed and care of horses	80
Driver	2 00
Total cost per day of hauling two tons	$ 3 00

Total cost, per ton, $1.50.

$1.50x45,000 tons equals $67,500 per annum.

The 45,000 tons will drain down to 22,500, so that is the amount to be reduced, or destroyed.

The cost of works to do the work will be in the neighborhood of $100,000 for a reduction plant, or $50,000 for a crematory. Assuming the former, interest and taxes on $100,000 will amount to $8,000 per year, the operating cost, exclusive of interest, but including coal, wages, salaries, etc., is believed on good data to be, say, 25 cents per ton. $.25x22,500 tons equals $5,625 per annum, so that the following figures give closely the cost of collecting and reducing, or destroying, the garbage of San Francisco at the present time:

Hauling	$ 67,500 00
Interest on plant	8,000 00
Operating	5,625 00
Total	$ 81,125 00

If this city were to do as is done in other cities, and pay a company to haul away and destroy the garbage, it would have to pay out each year the above amount. That my estimates are not far out of the way is proven by the experience of Buffalo, N. Y., where the sum of $35,000 per annum is paid a company to destroy all the garbage collected, no matter what the amount, and the city does the collecting. It costs the city nearly $40,000 per year to do the collecting, so that the total cost is nearly $75,000 per year. The poulation is somewhat less than in San Francisco, but the charge for disposal is higher than I have estimated, while the charge for collection is much less. From all data, so far collected, the city of Buffalo seems to pay much more for disposal than the majority of cities.

If the garbage is to be cremated or destroyed, then the above amount would have to be paid and, following the custom as stated above, in other cities, the city of San Francisco would pay it and the Board of Health would have to take charge of the work. The housholders would not have one cent to pay, except as taxes each year. They would be relieved of their present secessity of paying a certain sum per month to garbage handlers. The above amount would be at the rate of 27 cents per capita per annum. The city of Providence, R. I., paid a company 15 cents per annum per capita on a five-years' costract. The amount of wet garbage collected was in the neighborhood of 15,000 tons per annum, and the amount, therefore, reduced was about 7,500 tons.

The custom of paying a certain amount per year to garbage companies is a survival of the old custom of paying to get rid of the stuff, and some Health Officers insist upon it being completely destroyed. If cremated, of course, there is no income and the tax is a just one. In the last three to five years, however, the reduction of garbage has become a commercial success, and it is about time the cities stopped paying such a tax, and either derived some income from it, or at least had the work accomplished free of all expense to the people.

If reduced to products having a commercial value, at the lowest estimate for this city on the basis started on, there would be 4,500 tons of fertilizer, which, at $8 per ton, would amount to $36,000 per annum. Five per cent. is grease, which would give 1,125 tons, or 2,250,000 pounds. At 3 cents per pound, or $60 per ton, the value of the grease would be $67,500. Itemized:

Fertilizer .....$	36,000 00
Grease	67,500 00
Total receipts .....$	113,500 00
Operating expenses	81,125 00
Profits .....$	32,375 00

The foregoing figures should show pretty conclusively that a company might be able to put in a reduction plant and pay the city for the privilege. The plant could be run without expense either to the city or the householders.

In eastern cities the reduction business is of comparatively recent growth, and the cities, used to paying for cremation, are signing contracts with reduction companies to take care of the garbage at slightly lower prices than have been paid crematories. But since the fact has been ascertained that there is possible a profit in the handling of garbage, it is more than likely that when the contracts expire they will be renewed on slightly different terms. It may be that the cities will be paid by the companies instead of the cities paying the companies.

In the foregoing estimate we have only considered fertilizer and grease. There are other by-products of small value. There is also profit in picking over garbage, but it is not of great value. It is only when some company has charge of the whole business of disposing of refuse as well as garbage that these side issues can be considered.

The present franchise advertised for sale in this city contemplates the disposal of all refuse as well as garbage. It includes dead animals, and the only refuse not included is street sweepings. The price which can be charged is 20 cents per cubic yard, and this is delivered at the works. The people who haul the garbage must pay it, and the householders must, of course, reimburse the garbage handlers. It will thus come back on the people. It will be an indirect tax, and history has shown that indirect taxation is the worst of all kinds. The amount of it can never be thoroughly ascertained, but it is, nevertheless, a heavily felt burden.

The amount of refuse included in this franchise would probably aggregate one cubic yard per capita per annum. It might be double. At 20 cents per cubic yard, the lowest estimate will give the gross proceeds of the company at, say, $60,000 per annum. The operating expenses will be less than $15,000, so that there is a net profit of, say $15,000. At this rate the company could afford to cremate the garbage and forego the chance of posisble profits on reduction. The expense of hauling will be borne by the people, and the only expense the company will be under will be that of operating the plant.

Mr. Merle has offered the city $5,500 for the franchise. His bid has been accepted as the highest and, in effect, he offers the city the sum of $110 per year for the term of fifty years for the exclusive right to dispose of the garbage within the city limits, and thereby earn a sure profit of $45,000 per year if he totally destroys it. If he reduces it, his profits will be nearer $80,000.

Mr. Sharon offers $2,510 for the franchise, 2 per cent. per annum of the gross proceeds for the first fifteen years and 5 per cent. of the gross proceeds for the remaining thirty-five years. This, in effect, amounts to an offer outright of over $50 per year for the franchise and a percentage each year which will amount in the first fifteen years to $1,200 yearly and $3,000 yearly for thirty-five years longer. These figures are simply on the prospect that he will destroy the garbage. If he atempts to utilize it the amount paid the city will, of course, increase enormously.

The figures given have all been based on the present population and taken at minimum amounts. In actual operation, the amounts will probably be greater and the increase in population will of course play an important part in the problem. The percentage of refuse is greater per capita in a great city than in a small one. We cannot tell how valuable the products from the wastes of living will become, nor to what size this city will grow in the next fifty years.

ERNEST McCULLOUGH,
Consulting Engineer Merchants' Association.

San Francisco, Feb. 13, 1896.

Mr. McCullough asks that all who can furnish information regarding garbage disposal forward data to him.

DENVER'S CITY CHARTER AND PAVING SPECIFICATIONS.

We are in receipt of a lengthy communication from Mr. Arthur C. Harris, ex-President of the Denver Board of Public Works, on the subject of the recent decision of Judge Hallett, reported in the last issue of Paving and Municipal Engineering, holding that the Board of Public Works erred in specifying the kind of asphalt that should be used in street paving, by naming the source of supply. Leading up to this point, Mr. Harris says in his letter:

Knowing that you desire to place before your readers all matters of interest pertaining to municipal improvements, I propose giving you the unvarnished facts in reference to a case recently decided by the United States District Court in this city, as it may be a guide to charter-

makers and to city officials in charge of public improvements. Our city charter contains the following provisions:

"1. Before ordering the improvements mentioned in this section or any of them, the Board of Public Works shall adopt full details and specifications for the same, permitting and encouraging competition, etc.

"2. If owners of a majority of the frontage to be assessed shall petition for paving and for any particular materials for the wearing surface, the improvements shall be ordered and the material so designated shall be used; but no paving shall be ordered unless a petition for the same is first presented, subscribed by the owners of a majority of the frontage to be assessed for the same; and in every instance the material shall be so described in the specifications, either by standard or quality, as will admit of genuine competition between contractors, so that there can be at least two or more bids by individuals or companies, in no manner connected with each other."

The charter that contains these provisos went into effect in April, 1893, and on June 1st a new Board of Public Works went into office and the interpretation of the provisos as quoted was forced upon them at once, for on the 7th of June, 1893, a petition was presented to them signed by property owners, who asked for Trinidad Pitch Lake asphalt. Another company that proposed to use California asphalt insisted that the property owners had only the right to ask for asphalt, stone, wood or brick, or any other material by merely naming the material, as the charter provisos quoted above provided in the most unequivocal manner for competition that was genuine, and also stated that the board should permit and encourage competition. After hearing arguments, pro and con, the board submited the question to the city attorney who stated, in a lengthy opinion, that the board could not legally order paving on a petition that designated Pitch Lake asphalt from Trinidad, California asphalt, or any other asphalt by name.

This, meeting the views of the board, they rejected the petition and suggested to the attorney of the Colorado Paving Co. that they take the case into the courts and have them review the board's decision. This they have never done. The board let three contracts in 1893 and four for asphalt paving, one to a company that used Pitch Lake asphalt, and two to companies that used California asphalt.

This brings us down to the incoming of the present board, June 1, 1895, and to a review of their recent actions and the issuance of an injunction of the United States Court.

The contract that the board is trying to let is for the paving of Fifteenth street, about eleven blocks long, with asphalt, the petitioners merely asking for a sheet asphalt wearing surface equal to the best laid in Denver. At the first attempt to let the contract, the board had inserted the following changes in the specifications, that were a novelty, and were not in them when the ordinance authorizing the work was passed. They read as follows:

"In giving latitude to bidders to present their own formulas for compounding and laying asphalt pavements, it is expressly understood and required that the formulas must be for a pavement that has been used successfully and withstood the effect of street traffic for one year at least, in a dry climate, similar to the one in Denver.

"To enable the Board of Public Works to consider the formulas used, a copy of the formulas must be submitted to the board in separate envelopes at least twenty-four hours before the time set for opening the bids, and proposed bidders must state where the formula has been successfully used."

Others, not quite as objectionable, will not be quoted, time or space not permitting. It was conteded that these two paragraphs were unfair, and calculated to give an undue advantage to the two local companies who were bidders.

Mr. Harris, continuing, recites the facts regarding the subsequent action of the board, as reported in our last issue, changing their specifications to conform to the opinion of the Mayor, who was opposed to the paragraph quoted, and specifically naming three kinds and sources of supply of asphalts, which in their opinion, were the "standard and quality necessary to make a pavement of the character required by the specifications," and also naming other asphalts which they regarded as unsuitable and unacceptable. The court's ruling on the application for an injunction holding that this action was contrary to the charter, with the reasons set forth, was published in the February number of this magazine.

Mr. Harris says "the Board of Public Works has not yet intimated what their next procedure will be," and, in response to a letter from this magazine, we are advised by the board that they do not care to say anything further regarding the matter.

THE BRICK PAVEMENTS IN NEWARK, N. J.

To the Editor of Paving and Municipal Engineering:

In looking over your magazine this morning, I notice that in speaking about the brick pavements in this city you say that the brick have been laid on their sides. This is not so; they are laid on edge, and are not ⅜ inches apart. The most of the brick that have been laid are the Mack brick from West Virginia. We have laid about a quarter of a mile with the Canton brick. The only objection that the people make is the roar.

J. C. MUNDY,
Gen'l Supt. of Works.

Newark, N. J., Feb. 4.

THE GOOD ROADS MOVEMENT.

GOOD ROADS DISCUSSED FROM VARIOUS POINTS OF VIEW.

A symposium on good roads was a special feature of the New York Independent on Feb. 5. Ex-Governor Flower, of New York, in an article on "Good Roads for Farmers," said that a few years ago he collected statistics which showed that 2,700,000 days' work were assessed against the farmers of New York, and found further that the highway commissioners did not return one-fifth of this labor. He argued that the proper utilization of this labor under existing laws would give the farmers good roads. "If the farmers in any town of this State are earnestly in favor of good roads," he said, "and are bound to have them, they will have a stone-crusher and a road-scraper and will faithfully work out their tax. By concentrating their labor under the highway commissioner they will certainly get good roads, without the help of the Legislature."

Prof. N. S. Shaler, of the Massachusetts Highway Commission, contributed an article on "The Improvement of American Roads." There have been but few advances of public opinion which, even in this land of speedy changes, he said, have gone forward more rapidly than that which concerns our common roads. The movement really covers a period of about ten years. The experience of this country and of the leading European States has shown that properly to construct a road the builder needs have very detailed and accurate information as to the physical properties of the materials which he may turn to use. If the road is to be hardened by a covering of broken stone compressed by the use of the roller, it is very important to know the strength of the rock, its resistance to decay, and, above all, the cementation value of the dust which is to bind the bits together into a firm-set mass. As at least nine-tenths of our important ways have to be covered with broken stone, the method of obtaining knowledge as to its qualities is of much interest.

G. A. Roullier, C. E., tells "How Roads Should Be Made.'" He says a serious drawback to the rapid advancement of road improvement in the farming districts is the application of unnecessarily expensive methods—the result of copying. Whether a road should be built of plain macadam or built with an artificial foundation, is not to be decided upon haphazard. Where the soil is clayey, or where permanent subsoil drainage, if necessary, cannot be permanently assured, an artificial foundation of some kind is important. If this foundation is adequate and well built, it will in itself support the traffic and, consequently, needs a macadam top dressing, not to increase the strength, but only to furnish a smooth traveling surface. Four inches of well-compacted macadam stone has been found to give satisfactory results on heavily traveled roads, allowing ample room for wear before ruts formed and called for re-dressing. Any addition to that thickness—except where uniform wear was to be expected—would have added to the expense without adding to the period of fairness of the road. Rutting would have occurred as soon in the heavier coating as in the lighter one; the excess would only have permitted ruts to become deeper, and consequently more offensive, before cutting through to the foundation.

The temptation to secure extremely smooth roadways by using small stones for surfacing purposes, has caused the failure of many an otherwise well-built roadbed. The size of the macadam should be well adapted to the nature of the traffic; if the latter is heavy, small stones will be a detriment. While the heavily laden wheels will be pulverizing the stones at the road surface, they will also be breaking and gradually reducing the size of the stones within the bed, until finally the entire mass loses all power of resistance, ruts form, and the once fair surface is destroyed beyond economical repair. With macadam of suitable size crushing does not occur; the particles being more firmly wedged together motion is reduced to a minimum, and the internal wear—caused by the friction of the stones within the roadbed against one another—is also minimized. Deterioration of every kind is retarded; and, although the roadway will not be as smooth as one built of smaller material, yet it will remain in satisfactory condition much longer, give better service and be less expensive to maintain.

"City Streets and Asphalt Pavements" is the subject of one of the articles, of which Major J. W. Howard is the author. "Great progress," he says, "has been made during the past twenty years in the cities of the United States, especially in the matter of improved pavements. City after city, after long struggle, strong opposition and costly experiments has taken water works, sewers, pavements out of the hands of ignorant, apathetic and sometimes dishonest men, and intrusted these vital improvements to able men, and to men who, if they lack experience, are at least willing to investigate, inspect, tabulate and profit by the experience of men in other cities better equipped than their own.

"Our streets are used by almost every one almost every day, yet few persons realize that the paving problem is not yet fully solved, although great advance has been made. What to use and how to use it, in surfacing our streets, has perplexed the mental and financial resources of all cities since men have lived in communities. A city without pavements cannot maintain its economic existence. Goods cannot be moved. Progress even

on foot is impeded, street cleaning is impossible, and the health of all is in danger.

"Nothing is of greater benefit than a smooth, quiet, impermeable pavement, especially upon the roadway of a city street. This is made possible by the introduction of the concrete or monolithic foundation, as well as by the use of some form of special concrete either directly upon the the subsoil, or over the existing old stone-block, macadam, or other objectionable form of pavement for city streets. The foundation is surfaced with an asphalt pavement, which fulfills many of the requirements of what a perfect pavement would be.

"An even, noiseless and handsome pavement encouriges the efforts put forth to keep it clean. The entire neighborhood is influenced to a better appearance. The children which live and play upon the street enjoy a clean and quiet pavement and are much benefited by it. These children gradually become different from those who live near a dirty and noisy roadway.'"

Other articles treating phases of the subject are "Good Roads and Forestry," by B. E. Ferrien; "Taxing the Farmer for Good Roads," George G. French; "The National Government and Good Roads," Gen. Roy Stone; "An Instance of Good Roads," Maurice Thompson; "The Development of American Roads," George E. Walsh; "Good Roads for Wheelmen and the People," Col. A. A. Pope; "Village Improvement Societies and Good Roads," Helen E. Smith; "The Horseless Carriage," William Steinway, and "Roman Roads," J. R. S. Sterrett.

MEETINGS IN SEVERAL STATES.

A good roads meeting was held at Omaha, Neb., Feb. 4 for the purpose of discussing good roads for Douglas county. A permanent organization was effected to be known as the Douglas county road league, which will be managed by a board of nine directors, who shall elect from their number a president, secretary and treasurer; not more than five of the directors shall represent any one of the four classes of membership, which is composed of farmers, horsemen, wheelmen and commissioners. The board of directors elected officers as follows: President, G. R. Williams, Omaha; vice-president, A. P. Akerhund, Valley; secretary, G. H. Burchard, Omaha; treasurer, E. B. Henderson.

The board of trade, Mankato, Minn., has appointed George T. Barr, M. B. Haynes and H. P. Jensen a committee to co-operate with similar committees in other parts of the country in a movement to secure good roads.

A preliminary meeting was called by the good roads committee of the League of American Wheelmen Feb. 13 at San Francisco, Cal., to arrange for a reception to the bureau of highway commissioners March 3. Delegates from forty-eight organizations attended the meeting and were constituted a permanent organization to work for the improvement of the streets and highways of San Francisco. A committee of five was also appointed to submit a constitution and plan for permanent organization, to report March 10.

The New Jersey State Road Improvement Association met Jan. 28 in Trenton, N. J. After a general discussion on the subject of stone roads Gen. Roy Stone of the National Road Inquiry Department addressed the meeting. Resolution were adopted by the association recommending fixed salaries and allowances for expenses for the commissioners of public roads, the purchase by the state of stone turn-pikes and urging the passage of the bill providing for a national highway commission.

A good roads league was organized Feb. 4 by the citizens of Lafayette, La., for the purpose of improving the public highways. Officers were elected as follows: Dr. T. B. Hopkins, president; William Clegg, treasurer; Dr. N. Moss, secretary; Dr. J. D. Trahan, president temporarily. An executive committee of twelve was appointed to carry out the objects of the league and solicit subscriptions. The residents within city limits waived exemption to road duty and will contribute toward the maintenance of good roads.

GOOD ROADS DISCUSSED BY THE L. A. W.

The fifteenth annual assembly of the League of American Wheelmen met in Baltimore, Md., Feb. 10. The entire opening day was exclusively devoted to the subject of good roads. The meeting was in charge of the highway improvement committee and Isaac B. Potter, of New York, as chairman of that committee, occupied the chair.

The speakers were Mayor Kennedy, Allegheny, Pa.; Henry W. Williams and Mr. Miller, chairman of the commissioners of Allegheny county, Md.; A. C. Willison, president of Maryland division of L. A. W., and Sterling Elliott, chief consul of Massachusetts. Gen. Roy Stone of the bureau of road inquiry; F. G. Harrison, secretary of the New Jersey road commissioners; Edward H. Bacon, Louisville, Ky.; G. Richmond Parsons, Providence, R. I., chairman Rhode Island division committee on highways, Percy H. Richardson, Maine; A. Cressy, Morristown, first vice-president of the L. A. W., and Mr. Potter. Gen. Roy Stone said the wheelmen should help to encourage the farmers who are in hard luck by joining them in securing good roads. Make the farmers see that good roads will make the city people want to live in the country and will make them live there. Farmers can live on their farms in bad weather, when the roads are bad, but city people will not live in the country if they cannot get to the city. The government can and will do much, he said, when we have a national government highway commission. That commission can, by visits to different parts of states, gain a great influence in the road-building line. State aid to local effort is doing good work. No state is too good to help localities that will show an effort to aid themselves. The wheelmen can co-operate with the government by hav-

ing convicts work in quarries to crush the stone."

The general spoke of states in which convict labor on roads was successful. The objections to it, he said, were fast becoming less forced, and his department was preparing much printed matter which is to be sent to all interested. The chairman suggested that house bill 3,339, for a special committee on highways, be indorsed. This action was taken.

WHAT HAS BEEN DONE IN WISCONSIN.

The annual report of the first year's work of the Wisconsin League for Good Roads has been completed by Secretary Dorner, of Milwaukee. The League was organized Jan. 22, 1895, and the good roads sentiment created at the organization found expresion in two other meetings. The constitution of Wisconsin proprovides, in Art. VIII, sec. 10, that "the State shall never contract any debt for works of internal improvement, or be a party in carrying on such works." The provision was evidently incorporated in the constitution and intended to provent the making of excessive appropriations for railway purposes, but it is also a barrier to the introduction of any State aid system of road building. At the time of the organization of the league a session of the Wisconsin Legislature was in progress. Pending in the Legislature had been introducedshdrl uhrdluaenl dlu rdlu good roads, one of of which had been introduced by Senator McGillivray, and provided for the construction of highways in special cases, upon petition under the supervision of a civil engineer appointed by the county for the purpose and provided for a division of the cost of such improvements between the couty, the abutting property owners, and the State. The bill was constructed on the lines of the State aid system in operation in Massachusetts, New Jersey and elsewhere. The committee on legislation, which had been appointed Jan. 31, by the directors of the league, considered that it would be unwise to support this bill because, if passed, it would be unconstitutional. It therefore concentrated its efforts upon a bill introduced by Senator C. A. Youmans, which provided means and methods for for county road-bilding and for assessing part of the expenses upon the adjoining property; and upon another bill, somewhat different in its provisions and applying only to Milwaukee county, which had been introduced by Assemblyman E. D. Hoyt. At the meeting held Feb. 27, at Madison, the two bills were urged for passage, and Mr. Hoyt's bill subsequently became al aw. This was the first law directed toward the improvement of the county roads of Wisconsin.

MUNICIPAL REPORTS.

MANKATO, MINN.—M. B. Haynes, city engineer, in his report for the year ending Dec, 31, 1895, records some progress in paving. The first step toward a desirable and permanent improvement on Front-st., from Rock to Liberty, is a contract for placing 6,067 feet of curb and bed stone; 2,567 feet are now completed and the remainder will be done early in 1896. This is done at 58 cents per lineal foot, for furnishing and setting new curb and bed; 20 cents per lineal foot for setting old curb and furnishing and setting bed stone for same, and 9½ cents for setting curb and bed furnished by the city. This will be followed by the rebuilding of walks on uniform grade. Hickory-st., from Front to Second, has been macadamized with red gravel and good curb and gutter put in; it is too early yet to know whether the red gravel will give satisfaction or not. Second and Broad-sts. may be improved in this way, using screened gravel from the river in lieu of red gravel, and perhaps larger stone at the base, with about four inches of crushed stone; the expense would be light, and the streets excellent for light travel. The purchase of a steam road roller has proved an excellent investment. Mr. Haynes says: "Brick, as a paving material, is still growing in favor, improving in quality, as the manufacturers gain in experience, and at the same time being sold at a lower figure than formerly. Reports from cities in Iowa and Illinois where this material is largely used are very favorable, and new and extensive contracts for laying brick pavement are mentioned. While we concede the propriety of property-owners being consulted, and their wishes respected in the selection of paving material, we are convinced that a mistake will be made if anything less than a first-class pavement is put down on our main business thoroughfares. Asphalt, which is known as the best of pavements, has for the last year been furnished under a guarantee, at much lower cost than formerly, and is largely used in St. Paul and Minneapolis."

But little change has been made in the sewerage system during the year, only one short section having been added. There is only one locality in the thicklysettled portion of the city that is specially in need of sewers, and this will probably receive consideration at once.

Street sprinkling was done under contract for the season of 1895 at 30 cents per hundred feet per week for 6,800 feet, and 26½ cents per hundred feet per week for 24,206 feet. The city furnished the water, thus bearing a portion of the expense of sprinkling.

ALBANY, N, Y.—The annual report of Commissioner Gaus shows that the increase of granite paved streets during 1895 was 36,907 square yards, and the increase during the next year under contracts already let will be 56,541 square yards. The street commissioner is sup-

posed to be in charge of and responsible for the condition of all streets in the city. Mr. Gaus says that nominally this is true, but practically it is not. The water board claims the right to lay water pipes and mains in any and all streets, and during the last year the experience of the department has been most disagreeable. Aside from the injury done to lateral and intersecting sewers by the carelessness of those employed in laying the force main in Clinton-ave. and the condition of the pavement, the street commissioners had to spend the needless amount of $2,000. The total amount of repairing on Clinton-ave. was 10,682 square yards.

During the year 7,288 square yards of intersections were repaired; relaying a walk over the sewer on the south side of Central-ave. required 3,000 yards of flagging.

Mr. Gaus suggests that a certain portion of the old and broken-down brick, stone and wooden drains be taken up each year and replaced by larger ones, the city to assume one-half of the cost, and the property-owners benefited the remainder; in ten or fifteen years the work could be completed and the city provided with a sewerage system at a comparatively small outlay.

A vitrified brick pavement is recommended as a substitute for the present wooden pavement on the Hawk-st. viaduct. The purchase of a second-hand sweeping machine last August enabled the department to extend the sweeping area beyond the business portion of the city; during the period from April to December inclusive 11,917,020 square yards of streets were swept at a cost of $4,141; the cost of the removal of 6,549 cubic yards of dirt was $2,273.68, making a total of $6,414.68; during 1894 6,835.46 yards were swept at a cost of $4,039.75.

Mr. Gaus reported that the constant increase in the area of wooden pavements, which, under the law, must be kept in repair by the city, and the addition in the number of sewers and receiving basins has so increased the work of the department that the number of men allowed by the charter is not sufficient for its performance, and he recommends that provision be made for increasing the number.

The work to be done during the coming year is to be commenced as follows: Paving of Park-st. with brick, April 21; paving of Central-ave. with brick, May 15; pipe sewer in Broad-st., May 1; brick and granite paving in Dove-st., June 15; the same in High-st., June 15, and in Philip-st., June 15. Granite paving will be commenced on these streets as follows: Canal-st., April 15; Arch-st., Clinton-st. and S. Ferry-st., on April 20.

The work on the Northern boulevard and the Beaver creek sewer will be completed by May 1st next.

INDIANAPOLIS.—In his annual message to the council Mayor Taggart favors a continuance of permanent improvement of streets, not only within the mile square, but in localities where the value of abutting property and other conditions will justify such improvements. The narrowing the resident and cross-streets, where traffic is not heavy, to a width not greater than is necessary to accommodate the travel upon such streets, is favored. This reduction in width would greatly lessen the cost of improvements to property-owners, and the space between the curb and the sidewalks will be beautified with grass plots. Mayor Taggart says: "With reference to gravel I feel that it should find no place within the heart or business part of the city, where it comes directly in contact with the permanently improved streets, and that improvements on cross streets intersecting such improved streets should be of a similar character. This would enable the board to keep the streets clean, which is impossible so long as the dirt and mud are carried from unimproved streets and deposited on the asphalt, block or brick roadways. In the suburbs and outlying district of the city where no improvements have yet been made I am in favor of trying the gravel street if good gravel can be obtained."

ERIE, PA.—The report of George Platt, city engineer, for the year 1895, shows that .075 miles of brick sewer have been constructed, at a cost of $1,430.97, and 3.079 miles of tile sewers, at a cost of $28,246.75. Total length of sewers in the city: Brick, 10.507 miles; tile, 31.917 miles; total, 42.424 miles. During the year 1,321.26 lineal feet of asphalt paving was laid at a cost of $11,591.80, and 1,051.63 lineal feet of asphalt block at $8,276.72. The total paved streets in the city now are: Stone, 6.951 miles; sheet asphalt, 9.524 miles; vitrified brick, 2.409 miles; asphalt blocks, .199 miles; total, 19.083 miles.

Mr. Platt is not satisfied with the present system of inspection of sewers and pavements, and it is probable that a recommendation will be made to councils regarding it in the near future. The purchase of a testing machine is also thought advisable by Mr. Platt, for the purpose of accurately testing the strength of materials, especially cement and brick for paving purposes. The advisability is also doubted of passing a large number of ordinances for paving streets and letting contracts for doing the work when the same cannot be proceeded with on account of lack of appropriations for paying for street intersections. "If ordinances were drawn by which the intersection would be paid for by the property (as has already been done here in several cases), it would obviate this difficulty. Paving assessments are made in this way in most of the cities of the country, and as the city has to forever maintain the pavement after the property has been once assessed, it should not be considered a burden. Indeed, it would increase the assessment of each property-owner but a very small amount."

LOS ANGELES, CAL.—City Engineer Compton, in his annual report, says: "Sewage was sold from the outfall sewer last season for the first time. By means of valves on sections 3 and 6 the sewage is placed in a condition to methodically and reliably deliver the sewage upon the ground to be irrigated. The amount received from the sale of sewage for the

year 1895 was $3,278, and its maintenance cost was $2,137.97. The maintenance cost will in the future be but little in excess of that of the last season, but the receipts will be quadrupled when the sewer reaches its present capacity, which is one-half of the ultimate capacity."

During 1895 24.84 miles of sewers were laid under the Vrooman act and 2.52 miles under private contract; the total length of sewers up to date is 97.02 miles. Under the Vrooman act 5.12 miles of streets were graded and graveled and 5.32 miles graded and graveled under private contract, making a total of 137.32 miles in the city. There was no paving fully completed during the year, excepting Clay-st.

Of cement testing Mr. Compton says: "This department has probably done more for the city in exchange for the amount of money expended than any other. It has protected our public works from the use of inferior qualities of cement that otherwise would have been unavoidably used. The holds of vessels in which the foreign cements are shipped are sometimes flooded during storms. To save this from becoming a total loss, the cement that has become set is reburned, reground and "doctored" with lime, which makes it marketable, unless it be tested to detect the fraud. A cement that has once taken its initial set and is broken and remized loses from 40 per cent. to 60 per cent. of its strength. I am having a series of tests made developing the action and durable results of different brands of cement under different conditions, the knowledge of which will be of great practical benefit. In this report are diagrams showing graphically the relative strengths of the different brands of cement used in this city. In my next annual report I shall be able to give a very complete and valuable report from this department."

All cements are tested in the warehouses and receive the mark of the cement tester, if up to the required standard, and all cement taken from the warehouse and used in public works must be so marked. A system of daily reports shows the condition of all public work in reference to this department that makes it practically impossible for any amount of poor cement to be used, except in its specified proportions, without being detected.

NEW HAVEN, Conn.—The annual report of City Engineer Kelly says that during the last year five miles of new pavement were laid at an average cost of 73½ cents per square yard. The total length of sewers constructed during the year was thirty-two miles, and the length of sewers in use Jan. 1, 1896, was 84.392 miles. The cost of cleaning catch-basins was $3,566. The cost of all the new sewers laid during the year was $67,514.60.

HARTFORD, CONN.—The report of the street commissioner shows that some of the expenditures for 1895 were as follows: Road-making and repairing, $78,711; street-cleaning, $20,766; removing ashes, $11,332; removing garbage, $8,500. Attention has been called to the fact that there are 600 more houses than when the garbage contract was made, and the increase of houses has reduced available dumping grounds for ashes, etc., increasing trouble at each end of the bargain. More work has been done in cleaning the streets and more money spent. Bags for loose papers are to be provided, and the waste cans furnished by the request of the Civic club receive a word of commendation. The commissioners expect that City hall square will be paved throughout with block asphalt in the early spring, and that Main-st., from Arch to Windsor-sts., will be covered with sheet asphalt during the coming season. The commissioners report that everything is now ready to proceed with work on the intercepting trunk sewer.

BROCKTON, MASS.—The annual report of City Engineer Snow for the year ending Nov. 30, 1895, suggests that as soon as the assessors' maps for the city can be completed a systematic plan of the layout of streets for the whole city be made and completed by the city engineer, by authority of the city council, and that as soon as a system can be adopted necessary ordinances be framed and adopted to assure a uniform street system. Mr. Snow, after citing the city ordinances in relation to the connection of the city engineer with the streets, says: "If the city engineer and the superintendent of streets had been associated as architect and builder, respectively, in the past, there seems to be no reason why as economical results should not have been obtained as elsewhere where the combination has been perfected. A score of cities can be pointed out which have profited by this system. Besides the advantages which the committee on highways, which is ever changing its make-up, would have in a permanent clerical and statistical department the engineer would be better able to serve other departments in the interests of the city. For instance, in the park department alone, which must look to the city engineer as its executive officer, a practical knowledge of work on the highways, from the engineer's standpoint, would become of great value and significance to the park commissioners, and thus by serving one department to the full scope of a civil engineer, the office would become of greater value for the uses of this and other departments."

A detailed report is given of the work of abolishing the grade crossings, for which $1,200,000 has been expended so far. In relation to the park department, he says: "Another year has passed without any move having been made to establish a highway system for the proper development of the unoccupied territory of the city. This can be done by the city council, but prudence may suggest that the same end can be accomplished and broader purposes be served by the co-operation of the council and the park commissioners, whereby the scheme of public reservations and roads leading to them can be made a part of the scheme of a system of layout of streets for the whole territory of the city. The value of such a plan has not been recognized by the city government. If the city had been so laid out on plans, and city ordinances compelling real estate agents, syndicates

and owners to adopt the provisions of the official layout had been enforced, already parkways and main thoroughfares would have been built, at no cost to the city, and the knowledge that rules had been laid down and were controlling the lines of physical development according to a general comprehensive scheme, would have shown practical and beneficial results."

Mr. Snow, in speaking of the great detail work in the department of the city engineer, and the necessity which it involves of employing many assitants, says that "the efficiency of the department could be greatly augmented if the services of the young men who enter the department to become acquainted with field work could be retained when they are offered more remunerative wages elsewhere."

CAMBRIDGE, MASS.—The third annual report of the Park department reviews the steps taken during 1895 in developing the park system of Cambridge. The most important work of the year was the construction of a sea wall inclosing on two sides the area to be known as "The Front."

KALAMAZOO, MICH.—The annual reports of the city officials of Kalamazoo have been combined in a handsome cloth bound, gilt-edge volume. The committee on streets says that the pavements of Kalamazoo "are not what they should be." The pavements, however, cost but 90 cents a spuare yard, and on this point the committee says: "A 90-cent pavement is practically worthless, even on a street where there is no traffic, because within a few years it will be consumed with rot, and will have to be replaced with another pavement of the same kind. One substantial pavement at, say $2.50 a yard, will outlast six pavements at 90 cents a yard, even where there is no traffic, and where there is heavy traffic to lay a 90-cent pavement is a criminal waste of money. The first cost of a pavement is of great importance, but should be considered in connection with the life of the pavement, and the cost of maintenance for a period of, say, twenty years, or the estimated life of the pavement at the end of the period, and dividing the sum by the number of years, the annual cost of the pavement will be obtained. If the pavement should cost $2.50 a yard, and cost 5 cents per square yard for maintenance for a period of fifteen years, at the end of which time it would be almost as good as new, it would be a far cheaper pavement than one the first cost of which was 90 cents a square yard, but which had to be entirely renewed every few years."

The committee further suggests, and quite wisely, too, that "pavements suitable to the needs should be selected, and no objection on the part of any person or persons whatever should be allowed to interfere with the accomplishment of this plan."

City Engineer Taft says that in paving E. Main-st. and Kalamazoo-ave. an excavation to a depth of fourteen inches was made along the street railway tracks and the ties bedded in cement concrete. The space between the brick and rail was filled also with Portland cement concrete. The brick between the rails soon gave trouble by raising up, and as an experiment the Portland cemet concrete was taken out for a distance of about one hundred feet and this space refilled with paving pitch mixed with gravel. A stretch was also filled with paving pitch alone. Mr. Taft says: "It yet remains to be seen how much of a success these experiments are."

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

New York, N. Y.—English cork paving bricks are about to be laid near a hospital in this city.

Sandusky, O.—(Special).—A. W. Miller, City Clerk, says that no action has yet been taken toward paving Market street.

Topeka, Kas.—Wm. P. Emery, inventor of the new paper paving brick, has asked the council to let him test the merits of the brick by laying a section of pavement.

Springfield, Ill.—(Special).—C. M. Rickard, City Engineer, says: "During 1895 we have reconstructed 110,000 square yards of cedar block pavements with brick on a six-inch concrete base, at a cost of $136,812.50, which averages about $1.24 per square yard."

Tonawanda, N. Y.—Suit has been commenced by John T. Jones against the Town Board of Tonawanda to set aside the assessment roll for the paving of Delaware street in Tonawanda. He charges that there was not free competition in the bidding, and that the work was not done according to the specifications, being worth $100,000 less than was paid for it. He seeks to be relieved from payment of the assessment against his property.

Pittsburg, Pa.—The Pittsburg newspapers during the last month have contained several columns of criticism of street paving in this city, written by Oliver McClintock, a citizen who has been making investigations with this purpose in view. He charges that the local firm of Booth & Flinn have a monopoly on contracts of this kind, in consequence of which the Warren-Scharf Company and other companies withdrew from the field; that the specifications in many instances have not been complied with, and that bidders are confused by a rule of the Department of Public Works, that the specifications will be determined or chosen by the Director of Public Works after the proposals are received.

Poughkeepsie, N. Y.—A decision has been handed down from the New York Supreme Court reversing Judge Barnard's' ruling in a suit against the city of Poughkeepsie, in which action was brought by a property owner on Market street for the purpose of having set aside the assessment for the new asphalt block pavement. Application was made to Judge Barnard for a writ of certiorari to bring about a review of the assessment on the ground that it was not properly made, due notice not having been given the property owners, and alleging that there were other irregularities under the law. The application was denied, and now the general term of the Supreme Court grants it. The city will, therefore, have to show cause why the assessment should not be declared void. The total sum involved in the expense for paving the street is $14,000, most of which has been paid under protest. The plan was that each property owner should pay for the improvement in front of his or her property, but if the courts finally decide the assessment void, the city will have to pay the $14,000.

CONTEMPLATED WORK.

DeKalb, Ill.—Brick paving is proposed for Main street.

Joplin, Mo.—The road improvement question is being agitated.

Rich Hill, Mo.—Brick paving has been suggested for Park avenue.

Harrisburg, Pa.—Sheet asphalt paving is contemplated for Second street.

Canton, O.—Street paving is being considered, according to report.

Temple, Tex.—The question of street paving is still under discussion.

Altoona, Pa.—The construction of a road to Hollidaysburg is under consideration.

Marietta, O.—Paving is contemplated for Franklin, Second, Third and Fourth streets.

Marseilles, Ill.—The question of paving several blocks of Main street is being agitated.

New Castle, Pa.—Highland avenue will be graded and paved with asphalt blocks and curbed.

Winona, Minn.—Plans and specifications are being prepared for paving four streets with brick.

Pekin, Ill.—(Special).—Herman Becker, City Clerk, says that paving will not commence before June.

Youngstown, O.—Berlin street, between Federal and Clifton, is to be graded, drained and improved.

Kalamazoo, Mich.—Burdick street, from South to Ransom, will be paved with brick on crushed stone.

Hiawatha, Kas.—Paving is contemplated for about five blocks of the main street of this town.

Winnetka, Ill.—The construction of about seven miles of macadamized streets is contemplated for this year.

Meridian, Miss.—The macadamizing of certain streets is recommended by A. H. George, chairman street committee.

Macomb, Ill.—The City Council has decided to pave the public square and several of the streets leading from it.

Akron, O.—The estimated cost of paving Main street is placed at $12,000 by the City Engineer.

Killingly, Conn.—An appropriation of $3,000 has been made to macadamize the road from Killingly Center to Danielson.

Long Branch, N. J.—The question of building about fifteen miles of stone roads in Monmouth county is being considered.

Schenectady, N. Y.—A petition has been

presented to the Legislature for permission to issue $300,000 in bonds for paving.

Dayton, O.—Resolutions have been adopted for paving with brick or asphalt, Clinton and Montgomery streets and Xenia avenue.

Binghamton, N. Y.—About 20,000 square yards of asphaltic pavement will be laid this year.

Buffalo, N. Y.—A smooth pavement has been decided upon for Niagara street, not to exceed $1.75 per square yard.

Richmond, Ky.—(Special).—A. C. Wells, Clerk, says that the prospects for vitrified brick paving are very poor at present.

Omaha, Neb.—A macadam roadway on W. Leavenworth street is contemplated, from the city to the fair grounds, two miles.

Williamsport, Pa.—(Special).—J. J. Galbraith, City Clerk, says that bids will soon be published for paving Third street with brick.

Memphis, Tenn.—Madison street will probably be paved with brick. Main, St. Martin and other streets have been recommended, also.

Albany, N. Y.—The passage of a law is recommended for paving First street, from Hawk to Lark, with vitrified brick.

Kankakee, Ill.—An appropriation of $60,000 has been made by Council for paving the main streets with brick on concrete.

Des Moines, Ia.—Fifth street, at Clifton Heights, is to be paved with brick for the distance of nearly a mile.

Baltimore, Md.—An ordinance has been passed to appropriate $9,000 to pave York street, from Light to Johnson, with mosaic blocks.

Toledo, O.—Michigan street, from Walnut to LaGrange, will be paved with brick or block, on a hydraulic cement foundation.

Annapolis, Md.—A petition has been made to Congress by the Council for paving the streets adjacent to the Naval Academy.

Bedford, Ind.—(Special).—W. M. Denniston, City Clerk, says that some of the streets will be improved this season by grading, guttering and macadamizing.

Port Washington, N. Y.—The residents of this town will probably vote, April 7, on the question of macadamizing about three miles of the road leading to the turnpike at Manhasset.

Jeffersonville, Ind.—The township trustees have formed an organization for the purpose of improving the roads. Henry Nachand, president, J. A. N. Owen, secretary and treasurer.

Red Oak, Ia.—(Special).—Mayor Gunn says that no definite action has yet been taken regarding paving, but brick will be used when paving is done.

Meriden, Conn.—(Special).—Julius Augur, Street Commissioner, says that about 4,000 square yards of paving will be done and that the street committee has voted for brick.

Midland Park, N. J.—A petition has been presented to the board of freeholders asking their consideration regarding the macadamizing of the main thoroughfare.

Prestonsburg, Ky.—The question of building stone roads between New Albany and Sellersburg, Georgetown and Franklin, and Greenville and Lafayette, is being considered.

Oswego, N. Y.—A petition has been presented to the Common Council asking for a brick or asphalt pavement to be laid over the present pavement in W. First street, from Cayuga to Seneca.

Cincinnati, O.—Brick paving has been asked for in Lexington street, and asphalt in Kenyon avenue. Resolutions have been adopted for brick in Long alley, and granite in Colby alley.

Detroit, Mich.—Resolutions have been adopted ordering one mile of cedar block paving on concrete foundation, with stone curbing and cross walks. Jacob Guthard, President B. P. W.

Newark, N. J.—A petition has been presented to the street committe of the Board of Public Works, signed by nearly one thousand residents, asking for macadam paving in Riverside avenue.

Springfield, Ill.—(Special).—C. M. Rickard, City Engineer, says that about five miles of brick paving is contemplated during the coming season. The work will probably not be advertised before April.

Rochester, N. Y.—The highway commissioners of the town of Rose have called for an appropriation of $500 for the purpose of improving roads and bridges. A vote will be taken March 3.

McKeesport, Pa.—City Controller Herwick favors paving Market street with asphalt or brick, in sections, each year, until the street shall have been paved avenue.
from the river to Ninth or Thirteenth

Denver, Col.—The Board of Public Works instructed its engineer, Feb. 14, to prepare plans and specifications for asphalt paving for Broadway from Welton to Colfax avenue and around the Broadway hose house.

Brooklyn, N. Y.—Resolutions have been passed for repaving Green and Nostrand avenues with vitrified brick; a portion of Gates avenue and Court and Joralemon streets with asphalt, and sundry other streets with granite.

Ft. Wayne, Ind.—Brick paving is contemplated for Pontiac street, from Calhoun to Lafayette. A petition has also been presented to the Board of Public Works for paving Montgomery street, from Calhoun to Hanna.

St. Paul, Minn.—Fifth street will be paved with asphalt. Brick will be used on the grade from Cedar to Wabasha, the crossing at Robert street and the half block of Jasper pavement just above Sibley street.

Saginaw, Mich.—(Special).—R. J. Johnson, City Clerk, says that plans are ordered for asphalt paving for Genesee avenue, from Tilden to Jefferson. Other streets are under consideration and will be proceeded with one at a time.

Macon, Ga.—(Special).—An election will soon be held to determine the question of issuing bonds for paving the streets. Registration for this election begins on March 2. The character of paving has not yet been agreed upon.

Wilkesbarre, Pa.—The street committee recommends the grading, paving and curbing of portions of Bennett, Livingston, Oregon and Parrish streets and Conyngham avenue and Davis Place. A resolution has been adopted hereafter exempting churches from paying for paving in front of the property on which the church stands.

Nevada, Mo.—Mr. Robert Nesch, President of the Pittsburg Vitrified Brick Company, Pittsburg, Kas., estimates the cost of the proposed brick paving in this city at $1.50 per square yard, and this may be reduced by the fact that the city is willing to grade and prepare the street for work.

Saginaw, Mich.—(Special.)—R. F. Johnson, city clerk, says that plans have been approved, and bids will soon be asked for paving as follows: Thompson street, 810 square yards brick and 1,350 square yards cedar block; Genesee avenue, 8,360 square yards, asphalt; Lincoln street, 5,530 square yards brick. Paving is contemplated for three more short pieces.

Brooklyn, N. Y.—A committee of the Grand street Board of Trade has presented a list of streets to Mayor Wurster for paving, which is as follows: Driggs avenue, to Manhattan, asphalt; Roebling, granite; Marcy avenue, granite; Leonard, asphalt; Grand, asphalt; Berry, granite. Commissioner Willis contemplates paving a number of streets in the Twenty-sixth ward.

Scottsburg, Ind.—The Town Council passed an ordinance recently for seven blocks of vitrified brick paving, the cost to be defrayed by property owners in ten-year bonds under the Barrett law. Macadam was also ordered for as many more blocks. A remonstrance was made by the property owners, which proved ineffectual, for the board passed an order Feb. 24 to advertise for bids on two plans of vitrified brick paving and one on macadam.

Indianapolis, Ind.—The Board of Public Works has decided to improve the central mile square of this city, by paving the streets, including cross streets, with either asphalt or brick. Asphalt is to be used on the North Side, but it is deemed best to use brick for the heavily traveled business streets south of Washington street. Some of the streets to be improved this year are: Asphalt—New York, from West to East; Liberty, from South to Massachusets avenue; East, from Washington to St. Clair; Vermont, from West to East; Michigan, from West to East; North, from West to Meridian, and from Ft. Wayne to Massachusetts avenue. Brick—West, from Washington street to Kentucky avenue; Palmer, from Meridan to Madison avenue; Senate avenue, from Washington to South; Illinois, from Union Station to South; East from Washington to South; Alabama, from Maryland to a point 356.33 feet south. About twelve alleys in the original mile square will be paved with brick. Cement sidewalks will be laid in Thirteenth and Delaware streets and Kentucky and Capitol avenues.

CONTRACTS TO BE LET.

Redding, Cal.—Bids are invited until March 6 for grading streets. A. J. Drynan, Clerk Board Supervisors.

Mount Vernon, N. Y.—Bids will be received until March 3 for grading, etc., in Clinton street. Elias G. Peise, City Clerk.

Dubuque, Ia.—Sealed proposals will be received until March 8 for curbing and paving with brick W. Main and John streets. New curbing required, 1,000 feet, old curbing reset, 500 lineal feet, paving, 5,500 square yards. Check, $500. W. H. Hay, City Enginer.

Brooklyn, N. Y.—Sealed proposals will be received until March 3 for paving Forty-third street, from Second to Third avenue, with cobblestone.

Buffalo, N. Y.—Sealed proposals will be received until March 5 for repaving Bloomer alley and Preston street with asphalt, sandstone or brick.

Elizabeth, N. J.—Bids will be received until March 2 for 3,860 square yards of Telford and trap rock paving. N. K. Thompson, Street Commissioner.

Oshkosh, Wis.—Bids will be received until March 7 for paving with cedar blocks and curbing with stone Thirteenth, Kansas, Jackson and Church streets.

Norwich, Conn.—Sealed proposals will be recived until March 3 for building a macadam road in W. Town street. Selectmen Brown, Dickey and Spalding.

Port Clinton, O.—Sealed proposals will be received until March 7 for curbing and paving with brick Perry street, from Madison street to East Market space. Bond, $500. J. H. Faus, Clerk.

Oakmont, Pa.—Sealed proposals will be received until April 1 for a complete profile and grade plan of all streets and alleys in this borough. For further information, apply to the borough engineer.

Hartford, Conn.—Sealed proposals will be received until March 4 for laying about 20,000 square yards of Trinidad Pitch Lake asphalt or other asphalt equal in quality on Main street. Chas. H. Northam, President.

Terre Haute, Ind.—Sealed proposals will be received until March 3 for paving with brick or concrete the sidewalks on the east side of Tenth-and-One-half street, from Wabash to Poplar. Bond, $200. Chas. H. Goodwin, City Clerk.

St. Louis, Mo.—Sealed proposals will be received until March 6 for grading, granitoid curbing, guttering, telford pavement, limestone cross walks, dark blue oolitic limestone curbing, granite blocks, and vitrified paving brick in sundry streets, alleys and avenues. Robert E. McMath.

Trenton, N. J.—Sealed proposals will be received until March 3 for paving with vitrified brick, Mead street, from Clinton to St. Joe's avenue, and W. State street, from Calhoun street to the easterly line of Ewing township. Bond, $500 each. C. Edward Murray, Clerk.

CONTRACTS AWARDED.

New Brunswick, N. J.—Thomas Redhing secured the contract for macadamizing Fayette street, from New Brunswick turnpike to the Sound.

San Francisco, Cal.—M. C. Horgan has been awarded the contract for grading, macadamizing and curbing N street, from Fifteenth to Nineteenth avenues.

Albany, N. Y.—The contract for paving Swan street with vitrified brick was awarded to Patrick H. Reilly, at $1.89 per square yard.

Muscatine, Ia.—Flick & Johnson, of Davenport, Ia., were the lowest bidders, Feb. 20, on the paving contracts for both Galesburg and Buffalo brick.

Baltimore, Md.—Contracts were awarded Feb. 17 for paving and curbing certain portions of Eighth street as follows: Andre, Beason, Federal and Oliver streets, M. F. Leonard; Barclay street, W. J. Flannery; Clement, Laurale and Spring streets, Patrick Reddington.

Allegheny, Pa.—The contract for paving Sassafras Lane with brick was awarded to A. V. Purnell, whose bid aggregated $1,920.50. Seven bids were presented.

New York, N. Y.—The contract for repaving Melrose avenue, from One-Hundred and Forty-ninth to One-Hundred and Sixty-third street, with granite blocks was awarded to T. P. McQuade, 1328 Lexington avenue, for $7,752.

Rochester, N. Y.—The Rock Asphalt Paving Company was awarded the contract for paving Syracuse street with asphalt, at $2.50 per square yard, or an aggregate of $6,512.

Saginaw, Mich.—The contract for paving Warren avenue, from Genesee to Hoyt, with brick on concrete between the rails, and cedar blocks on concrete outside the rails, was awarded, Feb. 14, to Jas. C. Danforth, West Bay City, Mich.

Jacksonville, Fla.—The Tennessee Paving Brick Company, Robbins, Tenn., secured the contract for 47,000 square yards of vitrified brick paving, at $1.49 per square yard. The contract for furnishing 18,000 lineal feet of stone curbing was awarded to the Stewart Contracting Company, of Columbia, S. C.

Bloomington, Ill.—The contract for paving a number of streets with brick was awarded, Feb. 7, to John Cherry, jr., of Jacksonville, Ill. The work includes 92,000 square yards of brick paving, 51,000 lineal feet of stone curbing and 188 stone corners. Springfield brick will be used.

Des Moines, Ia.—The contract for paving Twentieth street, from Cottage Grove avenue to University avenue, has been awarded to O. P. Herrick, at $1.27 per square yard. The lowest bid for paving Ninth street with brick on concrete was presented by Dr. Likes at $1.41 per square yard.

Hoboken, N. J.—Bids were received Feb. 7 for asphaltic paving in Eleventh, Garden and Newark streets and Willow avenue from the Metropolitan Paving Company, the Barber Asphalt Paving Company, the Sicilian Asphalt Paving Company, E. T. Bradford and Henry & McGivney. The prices for asphalt ranged from $2.09 to $2.68 per square yard. All bids were referred to the committee on streets, to be reported upon at the next meeting.

Youngstown, O.—Davis & Caldwell presented the lowest bid Feb. 13 for macadamizing the Seceder Corners road. The bid was as follows: Excavating, 17 cents per cubic yard; macadam, 38 cents per square yard; paving gutters, 6 cents per square foot; box culvert masonry, $4.50 per cubic yard; old box culvert masonry relaid, $3.50 per cubic yard. Bids were received on the work from Con. O'Donnell, C. R. DeGroot and Geo. J. Vetter.

Minneapolis, Minn.—Bids were received from eight companies, Feb. 21, for asphalt and brick paving for the streets and avenues recommended by City Engineer Cappellen. Action will not be taken on the bids at once. The bids were as follows: E. M. Ayers, Assyrian Asphalt Company, Utah Wasatch lime rock asphalt, $2.50 per square yard with car tracks, without car tracks, $2.40; all pavements to be kept in repair the second ten years for 9 cents per square yard; Warren-Scharf Paving Company, Trinidad Pitch Lake asphalt, $2.45 per square yard on all streets; 9 cents per square yard for second period of ten years' maintenace; Western Bermudez Company, Limited, Bermudez asphalt, $2.51 per square yard on all streets; 8 cents per square yard for second ten years' maintenance; Trainor Bros., Galesburg or Des Moines brick, $1.77 per square yard, with 5 cents per square yard for second ten years' maintenance; Iowa Brick Company, Des Moines, Ia., common brick, $1.89; repressed, $1.99; 4 cents for second ten years; Des Moines Brick Manufacturing Company, bids ranging on different streets from $1.79 to $1.96 per square yard; Galesburg Vitrified Brick Company, common brick, $1.82; repressed, $1.94; Columbia Paving Company, Streator repressed brick, $1.99 per square yard; 9 cents per square yard for maintenance.

Peoria, Ill.—(Special.—A. D. Thompson, city engineer, says that bids received Feb. 25 for asphalt and brick paving were as follows: One course brick on 8-inch concrete, Washington street, 17,193 square yards—Mayfield & Awe, $1.52 per square yard; J. J. Jobst, $1.63½; McDonald & Son, $1.75; J. S. Allen, $1.77; one course brick on 6-inch concrete, Jackson street, 1,526 square yards, and Main street, 2,539 square yards—J. J. Jobst, $1.48½ per square yard; McDonald & Son, $1.75; J. S. Allen, $1.59, Mayfield & Awe bid on Main street only, $1.45 per square yard. Special brick on 6-inch concrete, Hamilton street, 3,215 square yards—J. J. Jobst, $2.25 per square yard. One course brick on 6-inch concrete, alley block 14, alley block 26, alley block 28—Mayfield & Awe, $1.25 per square yard; J. J. Jobst, $1.48½; McDonald & Son, $1.50; J. S. Allen, $1.60.

Asphalt paving, 2½-inch on 6-inch concrete, Hamilton street, 7,931 square yards—Warren-Scharf Asphalt Paving company, $1.84; Bermudez Asphalt Company, $2.05; Trinidad Asphalt Paving Company, $2.15; Hamilton street, 2,890 spuare yards—Warren-Scharf Asphalt Paving Company, $1.84 per square yard; Bermudez Asphalt Company, $2.07; Trinidad Asphalt Paving Company, $2.17. Madison avenue, 28,205 square yards—Warren-Scharf Asphalt Paving Company, $1.84 per square yard; Bermudez Asphalt Company, $1.92; Trinidad Asphalt Paving Company, $2.15.

Saginaw, Mich.—(Special.)—R. F. Johnson, city clerk, says that contracts have been awarded as follows: Carrollton street, 3,080 square yards, macadam, John C. Davies, $1,820.50; Washington avenue, 15,000 square yards, Scanlon & Crowley, $19,251.80; Warren avenue, 2,000 square yards brick and 8,200 square yards of sapless cedar blocks on concrete, James C. Danforth, of West Bay City, $11,833. Cement, castings, tile and sewer pipe will be furnished by the contractors.

SEWERS.

Missoula, Mont.—(Special.)—H. J. Hoblitzel, city clerk, says that the rumor that a sewerage system is contemplated is erroneous. About six miles of sewer was completed in 1894.

Springfield, Ill.—(Special.)—C. M. Rickard, city engineer, says that during 1895 one and one-half miles of brick sewer was constructed at a cost of $10,000. Also that a recent investigation of a seven-foot

single ring, brick sewer constructed two years ago shows it to be in first-class condition and as good as when first built.

Hartford, Conn.—The street board has recommended the rescinding of a resolution passed June 14, 1886, which requires the board to award all contracts for the construction of sewers to citizens only. The board thinks the resolution should be repealed in the interest of the city, so that bids for the intercepting sewer can be invited from people having the necessary equipment to do the work.

CONTEMPLATED WORK.

Holland, Mich.—A sewerage system is contemplated.

Sherman, Tex.—The sewerage question is being revived.

Clinton, Mass.—A sewage disposal plant is being considered.

Adrian, Mich.—The need of a sewerage system is urged.

Allentown, Pa.—The question of sewage disposal is under consideration.

Newton, N. J.—Oradell and Westwood are in need of a sewerage system.

Columbia, Mo.—The city council has sewerage and street improvements under consideration.

Independence, Mo.—The sewerage committee has asked for a bond election in March.

Niagara Falls, N. Y.—The Twenty-second-st. tunnel district sewer project is being revived.

Toledo, O.—Cylindrical brick sewers will be constructed in a number of alleys.

Beaumont, Tex.—The Reliance ditch will be extended and improved for sewer purposes.

Lexington, Mass.—A report will be submitted in March on the proposed sewerage system.

Racine, Wis.—Sewers 96 to 8-inch, average cut 12 feet, will be constructed.

Wyoming, O.—Plans have been prepared for sewers by E. F. Layman of Cincinnati.

Bayonne, N. J.—A trunk sewer is contemplated in Burdick-st., from South-st. to Arcadia creek.

Paterson, N. J.—Sewers are to be constructed in east Twenty-eighth and Coral-sts. and Madison-ave.

Somerville, Mass.—The council has not yet made appropriations for the proposed sewerage and paving construction.

Monmouth, Ill.—A sewage disposal system is needed. No definite action has yet been taken regarding it.

San Francisco, Cal.—About $16,000 will be expended in establishing sewers south of Berkeley and east of Golden Gate.

Depew, N. Y.—Plans have been approved for about 25,000 feet of sewers and for a sewage disposal plant.

Chillicothe, O.—Plans will be made for the proposed sewerage system by John P. Force of Fostoria, O.

Ottumwa, Ia.—A map is being prepared for a complete sewerage system in South Ottumwa by City Engineer Allen.

West Hoboken, N. J.—Ordinances have been introduced for the construction of sewers in Spring, Hill, Morris, Traphagen and West-sts.

Sharon, Pa.—A special election will be held March 20 to vote on the proposed sewerage scheme on the East side.

Springfield, Ill.—(Special.)—C. M. Rickard, city engineer, says that about two miles of sewers will be built during the coming season.

Reading, Pa.—A storm sewer, two miles long, eleven to four feet in diameter and an average cut of fifteen feet, is contemplated.

Zanesville, O.—Alexander Potter, C. E., 137 Broadway, New York City, prepared the plans for the sewers in the wards eight to ten.

Malden, Mass.—A petition will be made to the legislature for the right to issue additional sewerage bonds in the sum of $150,000.

Quincy, Ill.—Hiram Phillips, 810 Olive-st., St. Louis, Mo., has made plans for the proposed sanitary sewerage system in this city.

Toledo, O.—It is probable that Auburndale will have two systems of sewerage, one for house drainage and one to carry off storm water.

Barry, Ill.—A petition has been filed for the organization of a drainage district along the Illinois river in Pike and Brown counties.

Wilkesbarre, Pa.—Resolutions have been passed for the construction of sewers on Collins and Jones-sts. Sewers are also contemplated for Hazel and Moyallen-sts.

Duluth, Minn.—An outlet sewerage system will be constructed to cost from $40,000 to $150,000. Plans have been submitted by W. B. Patton, city engineer.

Irvington, N. J.—A sewage disposal system will be recommended to the village trustees by a committee consisting of Mahlon Drake, Franklin Kissam and George Higginson.

Central Falls, R. I.—An appropriation of $7,000 has been made for building filter beds to provide for the relief of the sewers in the western part of this city.

Washington, D. C.—A large number of new sewers are needed to replace obstructed sewers that are of no use and are a menace to the health of the city.

Batavia, N. Y.—J. J. Washburn, J. H. Bradish and A. W. Skelly, sewer commissioners, visited Worcester, Mass., Feb. 11 to investigate the intermittent filtration system of that city.

Norfolk, Va.—A petition will be made to the legislature for permission to submit to the people, in the May election, the question of issuing $150,000 in bonds for constructing a sewer in Brambleton.

Atchison, Kas.—(Special.)—A. C. Trueblood, city clerk, says that it will be some time yet before bids will be advertised for the proposed sewer, as the engineer has not yet completed the details.

Cedar Rapids, Ia.—A system of sewers will be built at a cost of about $3,000. The sewers contemplated extend from the east line of Fourth-st. to the east line of First-st.

Norwood, O.—An ordinance has been passed for building a complete sewerage system for the South Norwood district. The trunk sewer will be built up Lafayette avenue, in East Norwood, and down Serpentine avenue to Duck Creek.

Chicago, Ill.—Superintendent Claussen, of the sewer department, is preparing plans for several sewerage systems which are contemplated. The contract will soon be let for the Indiana street sewer and the W. Forty-seventh avenue sewer, also.

Newark, N. J.—A bill for the prevention of the pollution of the Passaic river provides for the construction of an immense trunk sewer through the valley of the Passaic to carry off all the sewage that is now dumped in the river.

Sacramento, Cal.—City Surveyor Mullenney says that, in his judgment, this city should have two pumps for use in the new sewage pumping plant, the capacity of each to be 12,000 gallons, instead of one pump with a capacity of 24,000 gallons.

Madison, Wis.—Mayor Alford, Alderman Hoven and Engineers Dodge and Nader made a recent visit to points in New York, New Jersey and Massachusetts, where sewage disposal plants which are operated by the chemical filtration process are in use, for the purpose of investigating them.

Ithaca, N. Y.—About sixteen miles of eight-inch laterals will be constructed this year. The first section to be let will be the rock work of the hills, including about four miles pipe, and the remaining twelve miles will be let in three sections, as seems desirable. Bids will also be asked for furnishing and erecting the pumping plant for the sewerage system.

Indianapolis, Ind.—Resolutions have been adopted for local sewers as follows: Michigan street, from Senate avenue to Roanoke alley; North street, Wood street, and first alley north of Michigan street, as follows: Beginning at sewer in Senate avenue at North street, thence west to Wood street, thence south to first alley north of Michigan street, with a branch in North street; New York street, beginning at Senate avenue and extending west 270 feet and branches in Ellsworth, Vermont and Osage streets, and first alley north of Ohio street; Clinton street, from New York to first alley north of New York street, thence east in alley to first alley west of East street; Vermont street, from East street west to a point 97 feet and 6 inches west of New York street.

CONTRACTS TO BE LET.

Mount Vernon, N. Y.—Sealed proposals will be received March 3 for constructing a lateral sewer in Overlook street, between N. Fourth avenue and Valla avenue. Certified check, $100. Elias G. Pease, Clerk.

Oakmont, Pa.—Sealed proposals will be received until April 1 for a complete sewer plan of the entire borough, giving dimensions of sewers and showing location of street inlets and manholes. Borough Engineer.

Kansas City, Mo.—Bids will be opened March 3 and the contract awarded for the construction of the O. K. Creek intercepting sewer, from Jefferson street west to Turkey Creek. H. H. Filley, City Engineer.

Winnetka, Ill.—Sealed proposals will be received until March 3 for constructing 7,885 feet of 6, 8, 9, 10, 12, 15, 18-inch pipe sewers, with catch-basins, manholes, etc. Certified check or cash, $200. F. H. Eno, Superintendent of Public Works.

Jacksonville, Fla.—Sealed bids will be received until March 3 for furnishing 500 to 600 frames and covers for manholes and flushtanks, valves, boxes and covers, and 40 to 50 catch-basins, frames and covers. Certified check, $1,000. B. F. Dillon, Chairman.

Providence, R. I.—Sealed proposals will be received until March 3 for constructing about 3,801 feet of 48 to 22-inch single and double course, circular and oval brick sewers and 430 feet of 15 to 8-inch pipe sewers in Elmgrove, Irving and Wayland avenues. Certified check, $2,000. Robert E. Smith, Commissioner Public Works.

Indianapolis, Ind.—Bids will be received until March 9 for a local sewer and all appurtenances in Vermont street, beginning and connecting with the sewer in East street and extending west to a point 97 feet and 6 inches east of the east property line of New Jersey street. M. A. Downing, President B. P. W.

CONTRACTS AWARDED.

Muscatine, Ia.—The contract for sewer construction will probably be awarded to Wilson and Jackson.

Cincinnati, O.—The contract for a sewer in Ravine, north of Streng-st., was awarded to Van Sandt & Meeds for $10,-101.40 Feb. 11.

Nyack, N. Y.—Bids were received Feb. 12 for constructing a sewerage system, but the contract has not yet been awarded. About twenty-seven bids were received.

Rome, N. Y.—The bids for constructing sewers numbered twenty and were received for the work as a whole, and for one or more sections of it. The contract has not yet been awarded.

San Antonio, Tex.—Samuel Katz & Co. was awarded the contract for constructing four miles of brick or concrete sewers at $92,144. The bids were submitted on brick sewers of both 16 per cent. and 26 per cent. absorption and on concrete sewers.

Wilson, N. C.—The contract for constructing five and one-half miles of 16 to 6-in. pipe sewers was awarded to A. C. Maynard & Co. of Richmond, Va., at $7,174. The Pomona Terra Cotta company of Pomona, N. C., has the contract for furnishing the pipe.

Jacksonville, Fla.—Bryan & Patterson secured the contract for the sewer extensions, which will require the laying of 39,897 feet of terra cotta pipe, 6,000 feet of cast iron pipe and the building of 2,936 feet of brick drain. The bid amounts to $35,044.

Buffalo, N. Y.—The lowest bids received Feb. 6 for sewer construction were as follows: Sewer in Hampshire and Ferry-sts., from Albany-st. to Elwood-ave., Jacob Ritzman, $32,464; Niagara-st., Ryan & Crandall, $690.45; French-st., W. G. Smith, $619; Reservation-ave., William Franklin, $640.

Indianapolis, Ind.—Gansberg & Roney secured the contract, Feb. 10, for a local sewer in Ohio-st., from Harvey-st. to Arsenal-ave., at $1.27 per foot. The contract for a local drain 210 feet long connecting with the Morton-st. drain, was awarded to the Indiana construction company at 80 cents per foot.

Minneapolis, Minn.—Contracts for furnishing 1,000,000 sewer brick and sewer pipe have been awarded as follows: N. P. Peterson, 200,000 brick, $5.60 per M.; John Berg, 200,000 shop brick, $5.97; Northwestern brick and fire roofing company, 200,000 brick, $5.75; Philip Reidel and B. Aronson, 400,000 Chaska sand brick, $6; Red Wing sewer pipe company, 15,000 feet sewer pipe.

WATER-WORKS.

CONTEMPLATED WORK.

Dexter, Mo.—Local capitalists are talking of constructing a water works system.

Louisburg, N. C.—Information is desired by the mayor, from engineers and contractors regarding a proposed water works system.

Skaneateles, N. Y.—A board of water commissioners will be appointed to deal with the question of water works for this village.

Water works systems are being agitated at the following places: Versailles, O.; Cassville, Wis.; Vicksburg, O.; Mabel, Minn.; Irwin, Pa.; Kingfield, Mo.

Durand, Ill.—Estimates of the cost of a water works system have been furnished by D. W. Mead of Rockford, whose figures range from $7,000 to $12,000.

McKeesport, Pa.—The water commissioners have been authorized to employ a hydraulic engineer to find the probable cost of supplying the city with water from the Monongahela river.

Remington, Ind.—The water works question is being agitated, and W. E. Peck, J. Guy and I. W. Yoeman have been appointed a committee to make investigations of cost, etc.

Idaho Falls, Ida.—More than one-third of the citizens were opposed to bonding for water works at the recent town election, but the matter will be reconsidered during the summer.

Albany, N. Y.—A bill in the senate authorizes the commissioners of public work of New York City to expend $1,000,000 for laying pipes and extending and enlarging the water sysetm.

The question of water works construction will be voted on at the following places: Keosauqua, Ia., March 2; West Springfield, Ill., April 2; Mediapolis, Ia., March 2; Jermyn, Pa., March 24; Troy, Pa.; Walnut, Ia., March 2; Cohocton, N. Y.; West Alexandria, O.; Schoolcraft, Mich.; Mount Ayr, Ia., March 2.

The construction of water works systems is contemplated at the following places: Martin, Tenn.; Llano, Tex.; Caledonia, N. Y.; Portville, N. Y.; Remington, Ind.; Osage, Ia.; Le Raysville, Pa.; Berlin, Pa.; Woodburn, Ore.; Galt, Mo.; Palestine, Tex.; Peekskill, N. Y.; Stanley, Wis.; Grand Ledge, Mich.; Osage City, Kas.; Hammontown, N. J.; Hart, Mich.; Pleasantville, Ia.; Loveland, O.; Merrimac, Mass.; Oakland, Md.; Fernville, Mich.; Skidmore, Mo.; Castle Rock, Wash.; West Acton, Mass.; Souderton, Pa.

CONTRACTS TO BE LET.

Yonkers, N. Y.—Bids are asked until March 5 for pipe and special castings. A. J. Lockwood, Clerk Commissioners.

Brooklyn, N. Y.—Sealed bids will be received until March 4 for furnishing 151,050 feet of 8, 12, 16, 20, 36-inch castiron pipe. Theo. B. Willis.

Philmont, N. Y.—Sealed proposals will be received until March 7 for the construction of a system of water works. Certified check, $300. F. B. Harder, Secretary Board of Water Commissioners.

Akron, N. Y.—Sealed proposals will be received until March 10 for constructing a system of water works. Certified check, 2 per cent. the amount bid. H. L. Newman, President Board Water Commissioners.

Boonville, Ind.—Sealed proposals will be received until March 10 for the construction of the whole or any part thereof of a system of water works. C. C. Ferguson, Secretary W. W. Co.

Le Sueur, Minn.—Bids are asked until March 3 for the erection of a 1,000-barrel water tower, laying 610 feet, 8-inch and 1,390 feet 6-inch mains, etc. Certified check, $200. Jacob Gist, Recorder.

Dublin, Ga.—Sealed proposals will be received until April 2 for the construction of a combined system of water works and electric light plant. Specifications and drawings will be furnished bidders at a cost of $1. N. B. Baum, Chairman.

CONTRACTS AWARDED.

Rockford, Mich.—The contract for a water works system was awarded to M. Walker.

Pomona, Cal.—The General Construction Company, of San Francisco, Cal., secured the water works contract for $59,976.

Waterbury, Vt.—The contract for putting in a new water works system has been awarded to L. A. Taylor, of Worcester, Mass., for $30,700.

Boston, Mass.—The contracts for building sections 2 and 3 of the Nashua, Mass., aqueduct were awarded to E. D. Smith & Co., of Philadelphia, for $370,826.

BRIDGES.

North Hatley, Que.—The Council has voted to construct a steel bridge.

Elkhart, Ind.—A bridge will be constructed over Christiana Creek at Simonton street.

Avoca, Pa.—A bridge is contemplated on the West Side. Ambrose Reese, City Engineer.

Rochester, N. Y.—The estimated cost of the proposed new bridge at West avenue is $75,750.

Menasha, Wis.—A new bridge is being agitated to cross the Little Lake Buttes des Mortes.

Whitehall, Mont.—A new bridge is being agitated to cross the Jefferson River, four and a half miles from this city.

Clarinda, Ia.—Bids are invited until April 8 for constructing all iron and steel bridges during the year.

Macon, Ga.—The question of building a bridge over the Ocmulgee River at Spring street is being considered.

Nashville, Tenn.—Plans have been prepared for a stone arch bridge over the Tennessee River, estimated cost, $378,000.

Sheridan, Mont.—A petition is being circulated for a bridge across the Jefferson River, near the Parrot works.

Traverse City, Mich.—The City Engineer will submit plans and estimates for a new bridge on S. Union street.

Morgantown, N. C.—Another iron bridge will be erected across the Catawba, near this city. Geo. P. Irwin, Chairman Commissioners.

Millers Falls, Mass.—A vote will be taken March 2 on the question of reconstructing a bridge recently washed away.

Iowa City, Ia.—Bids are asked until April 6 for constructing all iron and steel bridges during the ensuing year.

St. Charles, Mo.—A petition has been presented to Congress for permission to build a wagon and street railway bridge.

Ironwood, Mich.—The erection of a truss bridge at Suffolk street has been recommened. Carl E. Erickson, City Clerk.

Chillicothe, O.—The New Columbus Bridge Company secured the contract for a new bridge across the Scioto River for $7,837.

Harrisburg, Pa.—Nelson & Buchanan, Chambersburg, secured the contract for a new iron bridge across the Malesnonga Creek, for $3,700.

Boston, Mass.—Plans have been prepared for a new iron bridge across the Charles river, near the Beaver street boulevard.

Galveston, Tex.—Bids will be received until March 9 for a bridge over Clear creek, connecting Harris and Galveston counties.

South Sioux City, Neb.—An exclusive low wagon bridge is being agitated to cross the river in this city by Capt. Dick Talbott.

Sherman, Tex.—The sum of $1,500 has been appropriated for a bridge across Post Oak creek, at Jones and Cherry streets.

Perry, Okla.—The building of four bridges has been authorized, two across Black Bear and two across Red Rock. A. C. Hinde.

Red Oak., Ia.—Bids are asked until April 8 for constructing such iron and steel bridges as may be needed during the year.

San Francisco, Cal.—A bridge 100 feet long and 125 feet wide will be constructed over the north tunnel at Golden Gate park.

Dixon, Ill.—The contract for a bridge over Seven Mile branch was awarded to the Clinton bridge and iron works for $1,557.

Brooklyn, N. Y.—A bridge will be constructed over Newtown creek, from Manhattan avenue in this city to Vernon avenue in Long Island City.

Deckertown, N. J.—The freeholders have concluded to replace the bridge over the Papakating with a substantial iron bridge with stone abutments and approaches.

Saratoga Springs, N. Y.—The superintendent of public works has been authorized to construct an iron bridge over the Champlain canal in the town of Northumberland.

Shamokin, Pa.—A new iron bridge is being agitated to cross the Shamokin creek at the termination of Sunbury street, to cross the Treverton road.

Meridian, Miss.—Sealed proposals will be received until March 2 for building a bridge across Gin creek, on the Wild Cat road. B. V. White, clerk.

Washington, D. C.—A bill has been passed in the Senate for a memorial bridge across the Potomac, and $10,000 has been appropriated for the preliminary surveys.

Nebraska City, Neb.—Proposals are asked until March 5 for the construction of all bridges that may be ordered during 1896. Bond, $200. E. R. Hass, County Clerk.

Southport, Me.—The citizens will vote March 2 on the question of a bridge connecting this town with that of Boothbay Harbor.

Knoxville, Tenn.—The plans and specifications for a bridge across the Tennesse river at Gay street will be ready for inspection about March 4.

Topeka, Kas.—Sealed proposals will be received March 27 for the erection of the new Melan bridge across the Kansas river. Certified check, $5,000; County Clerk McCabe.

Saginaw, Mich.—The contract for constructing the superstructure of the interurban bridge across the Saginaw river has been awarded to the Detroit bridge and iron works.

Westmoreland, Kas.—Sealed bids will be received until April 13 for building a 45-foot span, 14-foot roadway, 4-panel iron bridge. Frank Davis, county clerk.

Jasper, Tenn.—An iron bridge has been decided upon by the bridge commissioners, J. W. McReynolds, A. J. Willis and G. W. Alley, to cross Little Sequachee river.

Chicago, Ill.—In his annual report Commissioner Kent says that at least eight of the city bridges must be rebuilt this year or else be closed to traffic.

Fergus Falls, Minn.—The Wrought iron bridge company, Canton, O., was awarded the contract for a bridge across the Red river, about two miles west of this city, for $1,793.

Logansport, Ind.—Bids will be received until March 5 for a bridge of three spans of 144 feet each. Each bidder must furnish his own plans. J. E. Crain, county commissioner.

Canton, O.—The Wrought iron bridge company was awarded the contract for the Ninth-st. bridge for $8,370 and the Canton bridge company secured the Laiblin road bridge for $6,362.

Toledo, O.—Bids will be received until March 5 for constructing stone abutments for a bridge over Ten Mile creek, on the Upton road, Washington township. C. M. Jones, county auditor.

Syracuse, N. Y.—A bill has been introduced in the legislature providing for a special appropriation of $10,000 for a stone arch or steel girder bridge across the creek at Cortland-ave.

Chicago, Ill.—Sealed proposals will be received until March 2 for the construction and erection of the steel spans comprising the superstructure of the viaduct on S. Halstead-st. Certified check or cash, $5,000. W. D. Kent, commissioner public works.

Chaska, Minn.—The contract for a steel draw-bridge across the Minnesota river, at the foot of Chestnut-st., was awarded to the Gillette-Herzog manufacturing company of Minneapolis for $9,200.

Mason City, Ia.—A suggestion has been made to the effect that a competent engineer be employed to make the necessary drawings and specifications for a stone arch bridge at the foot of Main-st.

Decorah, Ia.—Bids will be received until April 9 for furnishing materials and building such steel bridges, from 20 to 60 feet in length, as will be needed during 1896. Check, $500. O. C. Johnson, county auditor.

Portland, Me.—The Turkey bridge over the Presumpscot, near Back bay and Pride's bridge will have to be commenced this spring by order of the war department. It will be an iron span and will cost nearly $100,000.

Junction City, Kas.—Sealed proposals will be received until April 13 for the construction of a wagon bridge over the Republican river at Milford. Bidders will furnish complete plans and specifications. The bridge will be 400 feet long and not less than 16 feet wide. W. B. Spurlock, county clerk.

Elkpoint, S. D.—Bids will be received until March 12 for repairing the Calliope bridge on the Big Sioux river. A new pier, consisting of a pair of steel cylinders five feet in diameter and thirty feet long, with a solid plate and angle web, will be needed. Certified check, $500. A. P. Asbyeld, county auditor.

Canton, Ill.—Special.—G. W. Chandler, city engineer, says that a 75-foot span wrought iron and steel bridge has been completed over the east branch of the Copperas creek, in Orion township. The bridge rests upon one stone abutment and steel posts with one-quarter-inch steel backing; cost complete $1,792. The Indiana bridge company built the bridge.

PARKS.

Bristow, Ia.—A city park will be established.

Wilmington, Del.—The purchase of land is contemplated for park purposes.

Springfield, O.—The standpipe park will be improved and made attractive.

Kansas City, Mo.—Practical steps toward extending the boulevard system have been taken.

Clarinda, Ia.—The old fair grounds may be purchased and converted into a park.

North Adams, Mass.—A project for converting Colgrove cemetery into a public park is favorably regarded.

Charleston, S. C.—A boulevard is contemplated between this city and Summerville. Dr. C. W. Kollock is interested.

Quincy, Ill.—The council decided Feb. 3 to purchase ten acres of land in South Quincy for a park.

New York, N. Y.—The contract for the engineering work in laying out the new grounds for Columbia college on Morningside Heights, constructing sewers and the landscape work has been awarded to Waring, Chapman & Farquhar.

Toledo, O.—The park commissioners have elected George E. Hamlin president, S. C. Schenck vice-president and re-elected William Beatley secretary of the board.

Newark, N. J.—The Essex park commissioners have decided to locate a public park in the section of this city known as "The Neck."

Taunton, Mass.—(Special.)—The Dighton, Somerset and Swansea street railway has bought land for a park in Dighton, which it will improve this spring.

St. Paul, Minn.—Sealed bids will be received until March 5 for improving and ornamenting Grand-ave., between Floral and Lawton-sts. R. L. Gorman, president board of public works.

Atlanta, Ga.—A plan has been suggested for encircling the city with a boulevard which would touch all the parks and pleasure grounds. The suggestion is favorably received.

Chicago, Ill.—The plan of the West Park commissioners will soon surround this city with a matchless system of boulevards. Beginning at Jackson park it will be possible, when the connecting links are completed, to drive to South park, thence to Southwestern-ave. to the territory of the West Park board, then into Garfield boulevard to Humboldt park, across the park boulevard to Diversey-st., into the precincts of the North park board and east into Lincoln park; then north by means of the Sheridan road. The entire length of the boulevards is perfectly smooth.

GARBAGE DISPOSAL.

Almeda, Cal.—Garbage disposal by burning is under consideration.

Rutland, Vt.—The different methods of garbage disposal are being considered by the board of health.

Haverhill, Mass.—William Sawyer secured the contract for garbage disposal Feb. 15 for this year.

Cleveland, O.—An ordinance providing for the issue of $150,000 in bonds for a garbage disposal plant has been introduced in the council.

Baltimore, Md.—The question of garbage disposal will be investigated. An ordinance has been prepared providing for it by P. C. Hennighausen, president of the first branch of the city council.

Syracuse, N. Y.—The contract was awarded Jan. 28 to Daily & Aldrich for the disposal of the garbage of the city for a term of six years at an aggregate price of $126,000. Two plants will be erected, one on either side of the Erie canal, and the garbage will be collected and disposed of by a crematory system in operation in Philadelphia.

New York, N. Y.—The bids received Feb. 17 for the disposal of garbage were rejected by the board of estimate and apportionment owing largely to the reason that information received in response to requests for proposals indicated that more favorable results could be obtained if bids were called for on the basis of a lump sum per year, regardless of the amount of garbage, instead of on the price per ton. Five bids

were received, prices being per ton of 2,000 pounds, as follows: H. L. Fox, New York City, 50 cents; Merz universal extraction and construction company, New York, 90 cents; Z. F. Magill, Troy, N. Y., $1.15; R. Walter Peterson, Philadelphia, $1.44; William Kelly, New York, $1.48; the Merz and Peterson bid was for treating the garbage by utilization processes, and the other four bids were for burning it. It is probable that bids will be asked again very soon.

STREET SPRINKLING.

Sacramento, Cal.—The tax-payers have demanded better sprinkling service than they have had heretofore, and have asked the city trustees to so prepare the contracts for next season's sprinkling that flooding the streets will not be permitted.

Burlington, Vt.—A law enacted in 1894 empowers the city council to order any street or part of a street sprinkled when, in their judgment, the public good required it. The streets were to be sprinkled under the charge of the street commissioners, who were to assess the land or buildings of the owners of the abutting property on any street sprinkled, one-third of the expense on each side thereof, equally, for each lineal foot of frontage, and the city was to pay one-third of such expense. Previous to the passage of this law three sprinklers were used by the improvement company, who did the work. The city bought the sprinklers, and in February, 1895, four more were purchased from the Studebaker Bros. manufacturing company of South Bend, Ind. This winter petitions came in for sprinkling in other sections of the city, and an order was placed for several more Studebaker sprinklers, and the city council expects to increase the total to fifteen machines. The city owns the machines and the superintendent of streets employs the drivers and teams. The total cost of running seven sprinklers, including $1,508 paid to the water company, was $4,994, from April 1 to Nov. 15, and this includes 10 per cent. of the cost of the sprinklers, which is regarded as safe, as their life is from twenty to twenty-five years.

STREET CLEANING.

Des Moines, Ia.—Bids were received Feb. 12 for sweeping the streets for eight months, beginning the middle of April. J. A. Bryan presented the lowest bid, $440 a month, or $3,250 for the eight months, and it is probable that the contract will be awarded to him.

Columbus, O.—David Lakin, assistant superintendent of streets, suggests that the only way to secure the best work at lowest price is for the city to own a street cleaning plant. He estimates the cost of equipping the city for the work, with horses, machines, sprinkling wagons, two barns and sheds, etc., would cost about $60,000. If the city does not secure a street cleaning department Mr. Lakin believes the next best thing to do is to award the contracts and assess the costs on the foot frontage.

STREET LIGHTING.

Marietta, O.—A power house for the electric light plant is contemplated.

Albion, Ill.—Bids will soon be asked for constructing an electric light plant.

Newport, R. I.—The street committee of the Council contemplates advertising for bids for an electric light plant.

Dublin, Ga.—Bids are invited until April 2 for the construction of an electric light plant.

Lockport, N. Y.—A resolution has been introduced in the Common Council to put in a municipal lighting plant.

Des Moines, Ia.—An electric light plant, at a cost of about $50,000, is being discussed for this city.

Lewisburg, N. C.—F. N. Egerton is chairman of a committee appointed to secure information on an electric light plant.

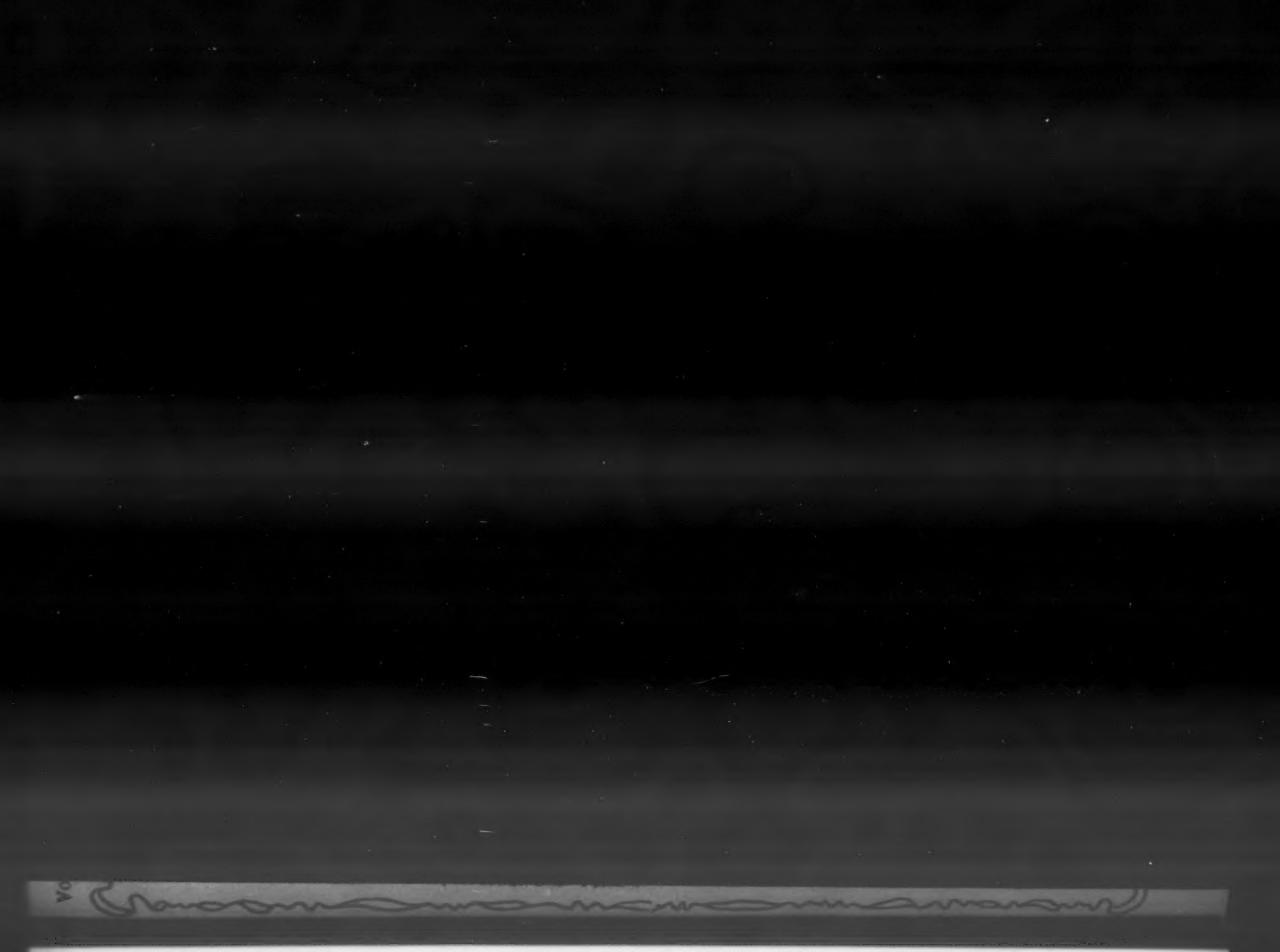
Winchester, Tenn.—J. L. Girton desires estimates on an electric light plant of arc and incandescent lights for a town of about 2,500 in habitants.

Electric light plants are contemplated at the following places: Greenwich, O.; Mitchell, Ind.; Winchester, Tenn.; Woodburn, Ore.; New Douglas, Ill.; Palestine, Tex.; Conemaugh, Pa.; Waverly, Tenn.; Bowling Green, Ky.; New Philadelphia, O.; Hart, Mich.; Mt. Pleasant, Ia.; Emmettsburg, Ia.; Hector, Minn.; Beatrice, Neb.; Mediapolis, Ia.; Alta, Ia.; Coffeyville, Kas.; Berryville, Va.; Burkville, Ky.; Anita, Ia.; Gainesville, Tex.

MUNICIPAL BONDS.

Maumee, O.—Sealed proposals will be received until March 10 for the purchase of $11,000 5 per cent. refunding bonds.

Glen Falls, N. Y.—The sale of $50,000 of water works bonds will take place in the village of South Glens Falls, March 4.

Port Clinton, O.—Sealed proposals will be received until March 7 for the purchase of $4,500 of 5 per cent. street improvement bonds. Check for $300. J. H. Faus, Clerk.

Preston, Minn.—Sealed proposals will be received until March 10 for the purchase of $18,000 of 5 per cent. water works and electric light bonds. M. R. Todd, Mayor.